The

DENTAL JOURNAL *of* AUSTRALIA

Contents

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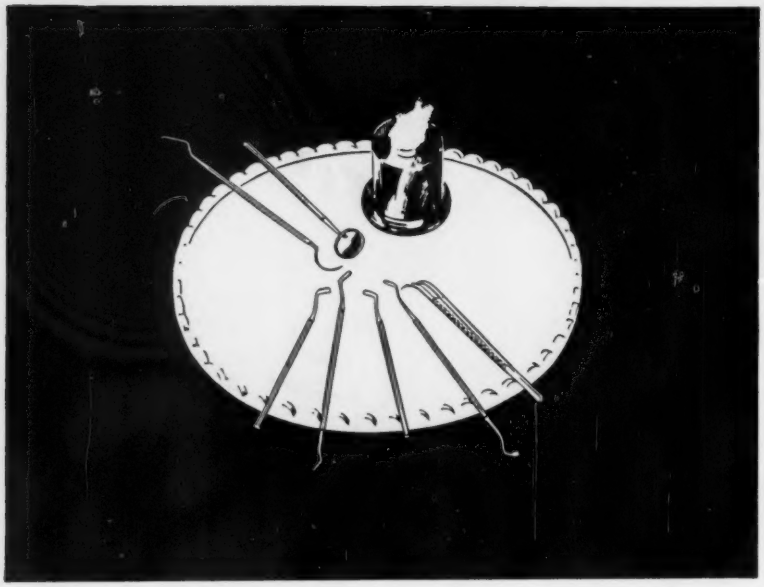

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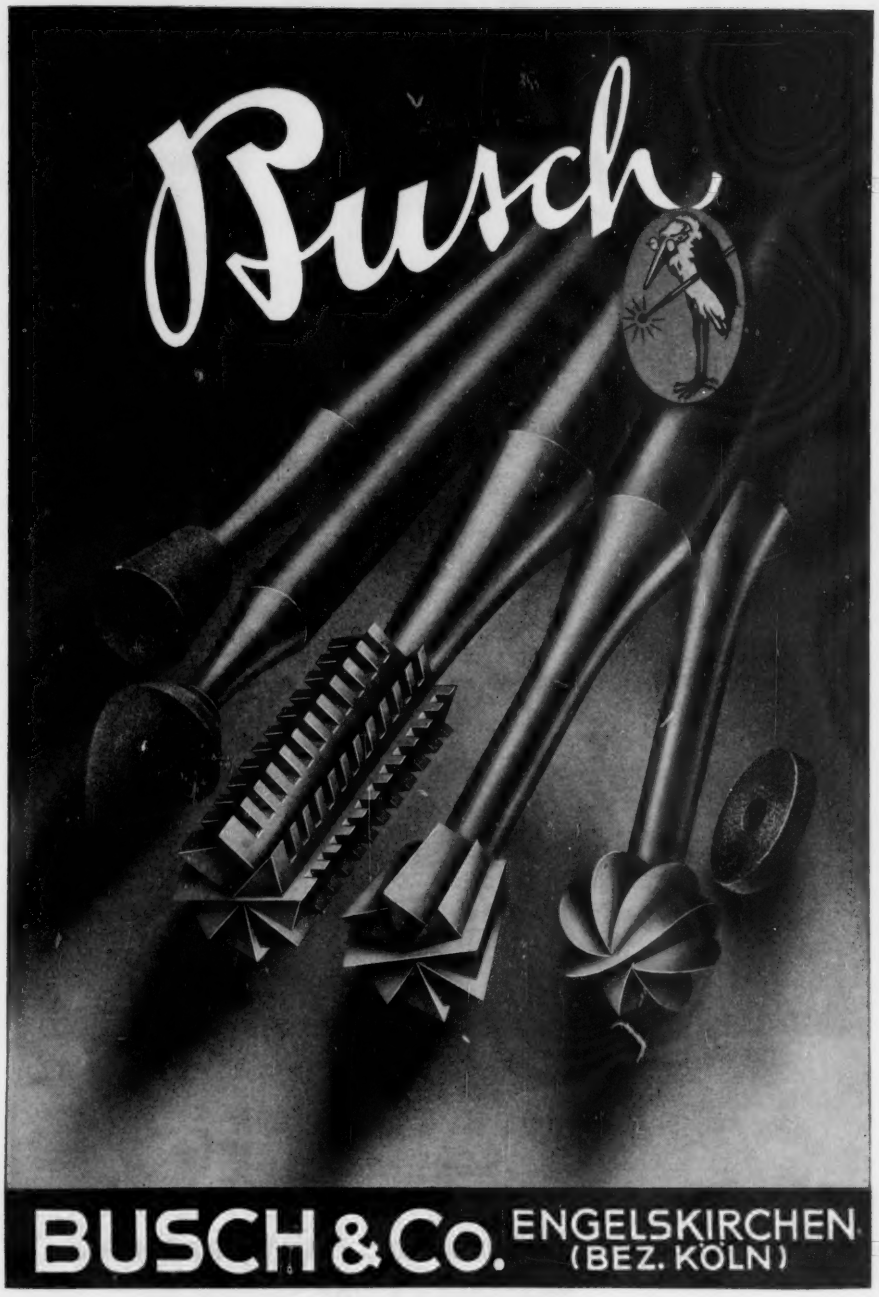
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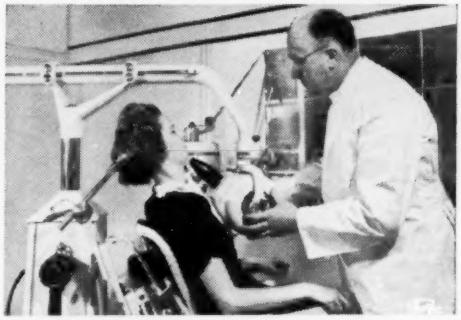

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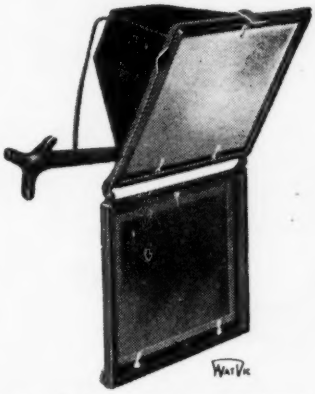

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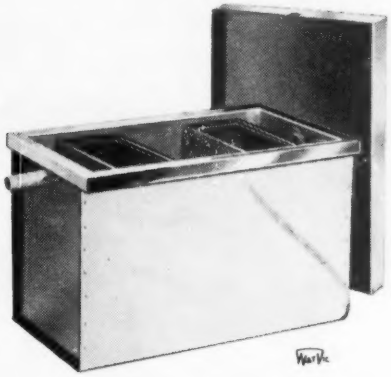

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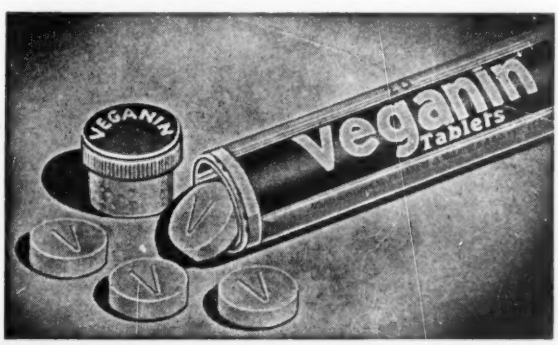

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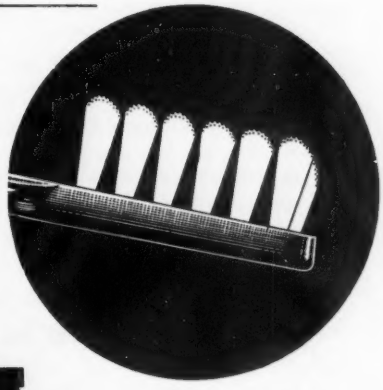

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Dental Research and Caries Control—Its Influence on Private Practice*

Basil G. Bibby, Ph.D., D.M.D.†

The problem of preventing dental caries can best be considered in the same way as the prevention of any other disease. The factor which determines the course of a disease is the maintenance of balance between the resistance of the tissue and the attack of the disease. Thus, the best way to prevent dental caries is either by increasing the inherent resistance of the tooth or by reducing the strength of the attacking forces. To this we can add another factor which might be considered as a balancing mechanism, which, if it bears on the side of resistance will increase the resistance, or if it bears on the side of the attack will increase the attack.

Let us consider these three factors. Firstly, how can the resistance of the tooth be increased? It is generally accepted that adequate nutrition is essential for the formation of well constructed teeth, and that such teeth will be more likely to resist the attack of dental caries. However, the question whether nutrition can influence the resistance of the tooth after the tooth has erupted, or whether systemic factors can influence the progress of dental caries acting through the erupted tooth, is open to considerable doubt. My interpretation of the recent findings concerning the vitality (or metabolism) of the tooth and, in particular, of the enamel, makes me believe that we cannot influence the resistance of the enamel through systemic changes. My reason for believing this is that the studies using radioactive isotopes, which make it possible to measure the amount of, say, phosphorus or carbon entering the enamel, have shown that the amount of radioactive material appearing in the enamel after an injection of the radioactive isotope is extremely small; and further, about three-quarters of this concentration penetrates the enamel from the external surface and not from the dentinal side. To me this means that the change in the phosphorus or calcium content of the tooth after it has erupted is influenced more by the salivary environment than by any variation in the composition of the blood operating through the pulp and dentine of the tooth.

Let us now consider what can be done to increase the resistance of the tooth by other than nutritional means. Firstly there is the effect of fluorine. This might be regarded partly as a nutritional effect. We know that fluorine increases the resistance of a tooth to dental caries and it is well-established that this is due to the increasing of the resistance of the enamel to solution. This is brought about partly as a result of deposition of fluorine during the period of tooth formation, but mainly as a result of the action of the fluorine on the tooth at the time of or immediately before or after eruption.

The effect of adding fluorine to the drinking water is well established. There are now five cities in the United States and Canada in which this effect has been studied over a period of six years and in all instances a reduction in caries incidence by at least 50% has been achieved. Such evidence, i.e., five independent studies each confirming the results of the others, proves beyond doubt that fluorine, added to the drinking water, will increase the resistance of teeth to dental caries.

Let us look now at the use of fluorine as a topical application to the tooth surface. There are now more than 20 studies embracing about 20,000 children in which fluoride applications of one sort or another have been made to the tooth surfaces. Nearly all of these show a reduction of approximately 40% in the amount of dental caries. There are a few exceptions, but most of them can be explained on other grounds. Again I think that this establishes it beyond reasonable doubt that topical applications of fluoride will add to the resistance of teeth to dental caries. Therefore, this procedure is worth using. It is worth noting that there are two techniques for making topical applications of fluoride, one being to make four applications within the period of two weeks and then to make no further application for a period of three years. This is the method generally recommended by Public Health Departments in the United States and it is particularly suitable for use in such organisations because of its economy in time and because it does not require repeated visits by the same groups. The second method consists of making a single application of sodium fluoride to the tooth surface each four or six months in conjunction with the periodic visits and prophylaxes given by the dentist. I believe this method is much more suitable for use in private practice. A number of dentists found that, using the Public Health procedure of making four applications and then postponing further applications for three years, had an unfortunate effect of making patients believe they

*Lecture delivered to a General Meeting of the Australian Dental Association (New South Wales Branch) on Tuesday, 17th November, 1953.

†Director, Eastman Dental Dispensary, Rochester, New York, U.S.A.

could stay away from the dentist for the three years in between the fluoride treatment. Therefore, I would suggest, for private practice, using the procedure of giving a single fluoride application following each prophylaxis. That I am sure, will have the effect of encouraging patients to come back to the dentist rather than staying away in between the fluoride applications. I do not think the concentration of fluoride solution is very important nor do I think the actual technique of application is very important. Any procedure which enables the isolation of the teeth to be made efficiently and the applications to be made to a clean and dry tooth surface is satisfactory. A simple way of maintaining a supply of sodium fluoride is to put an excess of sodium fluoride in the bottom of a pyrex bottle with water, shake it up and let it settle, and the supernatant fluid will be a 4% solution which can be diluted to a 2% or 1% solution as desired.

One is often questioned whether there is any significant danger attached to the addition of sodium fluoride to the drinking water. I think the simplest way to answer that is to point out that both the Committee of the National Research Council of the United States and the Investigating Committee of the Board of Health of Great Britain have reported that there is no reason for believing that additions of one part per million of sodium fluoride to the drinking water will have any ill-effect upon health. There are millions of people in the United States who have used water containing concentrations of fluoride far above the 1 p.p.m. all their lives, but so far medical science has been unable to show any ill-effects from such use of fluorine.

A few years ago some prominence was given to the idea that the resistance of the teeth could be increased by making applications of zinc chloride and potassium ferrocyanide—the so-called "Gottlieb" solution. This method has been tested by three independent departments of Health in the various States in America and so far, none of these tests has shown any benefit; so I feel that we can ignore that method of trying to prevent dental decay as it is time-consuming and, as far as I can see, has no sound theoretical justification.

So much for methods of increasing the resistance of the tooth to dental caries. We believe that the resistance can be increased by forming structurally sound teeth and by strengthening the teeth by the use of fluoride, either during the formative period or throughout life, in the drinking water or by application of fluoride to the tooth surface. Let us now consider the systemic factor, or "salivary effect." This may regulate the balance between the resistance of the teeth and the force of the attack. There are many difficulties attached to the investigation of saliva. We need not go into these at this time, but it is interesting to note that there is a growing belief that the saliva plays an important part in regulating or determining whether a given attack will be sufficient to cause caries. That saliva exerts a protective factor on the teeth is demonstrated by experiments in which the salivary glands have been removed from animals and then these animals placed on a caries-producing diet. The animals with the glands removed have shown about twice as much dental caries as the control animals. A further experiment has shown that, if the glands are removed and the animals are left for various periods of time before they are placed on this caries-producing diet, the amount of dental caries is directly proportionate to the period of time for which the animals have had their salivary glands removed — or stated differently — that the greater the period of absence of salivary glands the greater the amount of dental caries. In other words, the saliva is apparently contributing something to the protection of the teeth and yet we do not know what that is. It does suggest the possibility that systemic effects, which probably manifest themselves through the saliva, can be determinate in the progress of dental caries.

The third aspect of our problem is to my mind the greatest variable. How can we reduce the strength of the caries' attack? First of all, what is the nature of the attack? I do not think there is any reasonable doubt that the great attacking force is the acid formed by the fermentation of carbohydrates on the tooth surface, under the action of bacteria. That both bacteria and contact between the carbohydrates and the tooth surface are necessary has been shown by some interesting experiments. In the University of Notre Dame in America, animals have been raised aseptically. These animals are brought to full maturity without ever having had any bacteria or micro-organisms anywhere in their bodies. Such animals have been used to see whether they would succumb to dental decay when fed a diet which in the normal animal would produce decayed teeth. In no instance where these sterile (or aseptic) animals have been fed caries-producing diets has dental decay resulted. Therefore, it seems that the bacteria must be necessary. Further experiments have been carried out to decide whether the carbohydrates have to be in direct contact with the teeth to produce dental decay, or whether the effect can be produced by systemic means as a result of the over-all effect of the carbohydrates on the general state of the patient. These experiments employed the principle of feeding normal laboratory animals through a

stomach tube with a diet known to produce dental caries. This work has been carried out in two different places in the United States, and the results have been the same, namely that when the carbohydrate is fed through a stomach tube, so that it does not come in contact with the teeth, there is no dental decay. The animals which had direct contact between the carbohydrate and the teeth showed the usual amount of dental decay. Those in which the contact with the carbohydrate was avoided by means of the stomach tube showed no dental decay.

These two experiments, I believe, indicate beyond reasonable doubt that both the bacterial action and the contact of the carbohydrate with the teeth are necessary to cause dental decay. They also suggest two ways of limiting the caries attack—firstly, by reducing the activity of bacteria on the carbohydrates and, secondly, by reducing the contact between the carbohydrates and the teeth. In respect to the first approach, that of reducing the activity of bacteria, there has been a great deal heard recently, particularly in the dentifrice advertisements, about methods of combatting bacterial activity by the use of ammoniated dentifrices, chlorophyll and the like. There are new agents appearing on the market in the United States which are supposed to reduce the activity of the bacterial enzymes and in that way prevent the bacteria from forming acids from carbohydrates. Time does not permit a full discussion of those things, but it is safe to say that the action of none of them has been satisfactorily established. The use of the ammonium ion has now been generally accepted to be unsound in principle and unsatisfactory in practice; chlorophyll has never been demonstrated to reduce dental caries in human subjects and the effect of new anti-enzyme dentifrices which are very popular in America at the present time is not proven. So far, the evidence on which they are based is purely laboratory experimentation and it has yet to be established whether they will actually reduce dental caries. So I do not feel that we should place too much trust in such "magic" preparations and I think it is a safe rule for the general practitioner not to bother too much about these new panaceas until they have been tested and proven in several different places by University or other groups which are in a position to carry out such studies. I think it is time to start recommending these dentifrices to patients, when we have such confirmatory clinical studies based on sound laboratory studies.

The second approach in reducing the caries attack is that of reducing the amount of contact between the carbohydrates and the teeth. This again can be approached in two ways. The first way would be to select foods which because of their inherent physical nature will adhere to the teeth less than other foods. We have over the past few years been attempting to differentiate between the foodstuffs which adhere to the teeth in large quantities and those which adhere in smaller quantities. Some general findings have emerged which at this stage have interest but not much practical usefulness. They indicate that the length of time or the amount of a particular carbohydrate-containing foodstuff which sticks to the teeth is not related directly to the stickiness of that foodstuff, and that factors such as the fat content of the food are equally as important in determining the amount of food which will stay on the teeth.

It is hoped that as this work is continued we will be able to suggest one group of foods which, because of differences in texture or fat content, or degree of salivary stimulus which they evoke, will stick to the teeth in very small quantities and therefore be less conducive to dental caries and another group which have the reverse properties and which we believe to be of primary importance in causing dental caries. When such a differentiation is made, it will be possible to suggest to patients that they select foods from the first group rather than from the second and in that way I think a more practical approach to reducing the ill-effects of carbohydrate contact with the teeth will be made than if we recommend complete abstinence from carbohydrate foods. I do not believe that is practicable.

The second way of reducing the carbohydrate contact with teeth is to reduce the number of acid attacks on the tooth surface. When carbohydrate foods are eaten they do not adhere to the teeth for a very long period of time; most of the carbohydrate is removed from around the teeth within about 15 minutes. Therefore, after each meal (and each time we eat carbohydrate) there is a period of only about 15 minutes in which there is a significant concentration of carbohydrates on the tooth surface. This means that the length of time in which we have carbohydrate in contact with the tooth surface will be determined more by the frequency of eating than the total amount of carbohydrate eaten, suggesting that dental caries might be more directly related to the frequency of eating rather than to the total amount of carbohydrate eaten. Further evidence has been obtained by studying the acid formation in plaques on the tooth surface following the eating of carbohydrates or the washing of the mouth with sugar solutions. These experiments have confirmed the fact that the period of time in which there is a sufficiently high concentration of acid in plaques following the use of carbohydrate foodstuff is of only ten

or fifteen minutes duration and therefore the period of time for which we have this dangerous concentration of acid on the tooth surface is only ten or fifteen minutes after each use of carbohydrate food. Therefore, if we eat only three times a day we have only three short periods during which there is an acid concentration on the tooth surface, but if we eat the same amount of food and divide it into ten or fifteen portions, then we will have ten or fifteen periods during which there will be a dangerous acidity on the tooth surface. In other words, we have come to the same conclusion as before, that the strength of the caries attack is more directly related to the frequency of eating carbohydrate foods than the total amount of carbohydrate food eaten. This is in keeping with clinical observations such as the common observation of a low rate of dental caries in children living in institutions where their diet is strictly controlled; and observations of a reduction of dental caries in rationed population groups during the recent war. I think this is a very practical approach to the reduction of dental caries. Let us suggest to our patients, not that they concern themselves too much with the total amount of carbohydrate eaten but they pay attention to the frequency of their eating it; I think this is more practical advice than suggesting complete abstinence from carbohydrates. I have taken advantage of this principle in raising my own children. Our procedure is to discourage as strongly as we can the eating of sweets or sweet foods between meals. However, we allow them to bring home any sweets that they are given or which they buy, and eat them after the next meal, and we encourage them to clean their teeth when practicable as soon as possible after the meal. If this is done, parents are in a better position to get co-operation from their children, and it is a realistic approach to the control of dental caries. I also feel that, although we are not in a position to make specific recommendations yet, the time will come when we will be able to offer a list of foods which can be eaten between meals without producing dental decay, but that must wait for the future.

By way of recapitulation I have tried to stress the following points. Firstly, the resistance of the teeth can be increased in two ways: by obtaining sound teeth by adequate nutrition during the period of tooth formation and by the use of sodium fluoride which can be administered through the water supply. Where there is no communal water supply which can be treated, topical applications of fluoride to the tooth surface should be made. Secondly, we believe that the saliva adds to the resistance of the tooth, but as yet we do not know how to affect this mechanism. Thirdly, as a means of reducing the attack of dental caries, the all-important advice is to reduce the frequency of eating carbohydrate foods. If this is done, the attack is weakened and I am sure that progress can be made in reducing the rate of dental caries.

The Use of Local Anaesthesia in General Dental Practice*

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Introduction.

The object of this paper is to describe briefly some of the techniques used to produce local anaesthesia, to review some of the advantages and disadvantages of these techniques, to discuss some of the reasons for failures and the complications which may arise from careless administration, and to attempt to convince the dentist in general practice of the value of its extensive use.

Techniques.

Before using any technique for any particular method of anaesthesia, a thorough knowledge of the anatomy of the area concerned and the ability to recognize certain land marks is essential. In dentistry our field of local anaesthesia is limited for all practical purposes to the maxillary and part of the mandibular branches of the trigeminal or 5th cranial nerve.

(1) *Infiltration or Supra-Periosteal Injection.*

This injection is useful for anaesthetising anterior teeth, upper bicuspids and lower first bicuspids. The object of the injection is to deposit anaesthetic solution against the periosteum opposite the apex of the tooth concerned.

Figure 1 shows an average upper and lower anterior tooth. It can be seen that the apices of the teeth are not very far beyond the mucobuccal fold. For this type of injection I use a Leur-lok type syringe with a straight adaptor, short hub and a 42 mm. shimmel needle. The needle is inserted in the mucobuccal fold with the fluted edge towards the bone and the solution is deposited at the estimated depth.

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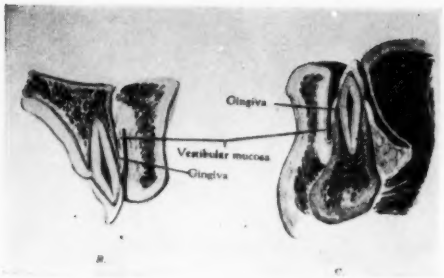

Fig. 1.—The relation of the muccobuccal fold to the apices of anterior teeth.

There are two factors which may be concerned in the existence of an unsatisfactory anaesthetic level. They are: (a) variations in the anatomy of the area, (b) the density of the cortical layer of bone. Figure 2 (a) and (b) shows variations which may occur in the anatomy of the bone supporting a central incisor. In figure 2 (a) the point of the needle will no doubt come up against the nasal spine of the maxilla and the solution will probably cause a ballooning of the lip and fail to reach the nerve supply to the tooth. An additional injection on the palatal side may provide the required anaesthesia but in this particular case an intro-osseous injection would be preferable. In figure 2 (b) the anatomical formation should be ideal for infiltration anaesthesia.

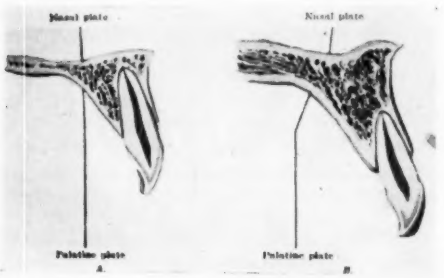

Fig. 2.—Variation in the bone supporting an upper central incisor.

Variations also occur in the anatomy of the upper lateral incisor. The root of this tooth often turns palatally towards the apex. It is noticed sometimes, when doing an apicsectomy, that the anaesthesia is satisfactory until the bone on the palatal side of the granuloma is curetted. The addition of a palatal injection will suffice in most cases.

The upper canine seldom presents any difficulty but the upper first bicuspid with bifurcated roots sometimes may do so. Here it appears to be a matter of the distance the solution has to penetrate. The addition of a palatal injection should complete anaesthesia. In the maxilla, the alveolar cortical bone in the anterior region is seldom too dense to allow the absorption of anaesthetic solution. However, should this condition be encountered the difficulty can be overcome by the use of an intra-osseous injection. The cortical bone of the mandible is quite dense and does not allow very satisfactory penetration of anaesthetic solution except in the anterior region. It is better to use a mandibular block than to attempt infiltration anaesthesia for the mandible posterior to the canine area. Some practitioners claim that satisfactory anaesthesia can be obtained in the posterior region of the mandible by infiltration in child patients. Personally I think a mandibular block the easier and more positive.

Fig. 3.—An X-Ray showing the position of the needle when giving an intra-osseous injection.

(2) *Intra-Osseous Injection.*

For this method a Leur-lok type of syringe with a long hub and short needle is used.

A small amount of anaesthetic solution is injected into the mucosa between the roots of two teeth, one of which is required to be anaesthetized. A small hole is then drilled through the cortical bone into the cancellous bone using a Gates-Glidden bur or root reamer just slightly larger than the needle. This hole should be a little deeper than the length of the needle. When drilling this hole it is well to keep the drill spinning forward as it is withdrawn. This extracts any tiny pieces of bone which may sequestrate and cause a little post-operative soreness. The needle is then inserted up to the hub and the solution is injected with gentle pressure.

The ideal position for the needle is for the point to be close to the apices of the teeth

(Fig. 3). This technique is ideal for one tooth or two adjacent teeth in the anterior region. There is no feeling of ballooning of the tissues and it is my choice for conservative work in the anterior region of the maxilla. Its main disadvantage is the risk of infecting the underlying tissues but this should not happen if proper asepsis is observed. Van den Berg[1] has referred to the disadvantage of the great amount of pressure that is sometimes required. I have found that great pressure can be overcome by withdrawing the needle and making the hole about another millimetre deeper. The solution will then usually flow without excessive pressure.

Van den Berg uses a drill which appears to only drill a fixed distance all the time. If great pressure is used one will usually find that the teeth concerned are tender to percussion for a day or two afterwards, Grainger[2] also agrees that pressure is neither necessary nor desirable.

Fig. 4.—The external landmark of the infra-orbital foramen.

I use this injection frequently for carrying out conservative work on upper anterior teeth and bicuspids and have never found greater pressure is required than a glass syringe will stand. Care should be taken when drilling in the bicuspid region not to puncture the antrum.

This technique should be avoided between the central incisors. The dense union at the symphysis of the premaxillae and the presence of the anterior palatine canal are contra-indications. If the bur does not penetrate the bone easily the site should be x-rayed before proceeding any further. There may be a root fragment or some other obstruction. Amies[3] states that pre-operative x-ray is obligatory. The needle should never be allowed to bend.

(3) *Injection of the Infra-Orbital Nerve.*

The technique for this type of anaesthesia is to deposit anaesthetic solution opposite the infra-orbital foramen, thus conduction anaesthesia will take place from the solution penetrating posteriorly into the infra-orbital canal. The syringe and needle used is similar to that used for supra-periosteal injections. The usual method used is to palpate the infra-orbital ridge, and, when the patient is looking straight ahead, the foramen is located approximately 1 cm. below the infra-orbital ridge and directly below the pupil of the eye (Fig. 4). The point of the needle is inserted into the mucobuccal fold between the two maxillary bicuspids and, whilst holding a finger over the foramen, the solution is deposited under the finger (Fig. 5). Anaesthesia of the central, lateral, and canine should result.

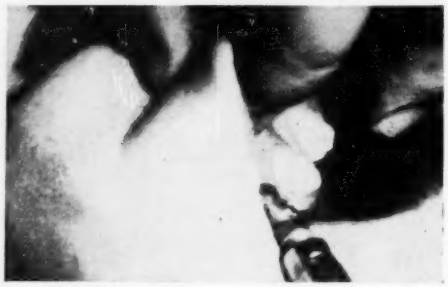

Fig. 5.—Method of injecting to anaesthetise the infra-orbital nerve.

Before the solution is injected it is wise to carry out an aspiration test because of the presence of the canine plexus. I have not much use for this injection for several reasons; firstly, the solution has to infiltrate posteriorly down the canal to be effective; secondly, there is the possibility of a secondary nerve supply to the central and lateral incisor; thirdly, in the cases of extraction, or surgery, palatal injections are still required.

However, this technique is useful for the injection of alcohol in the cases of neuralgia.

Fig. 6.—Site of injection for the posterior superior nerve.

(4) *Injection of the Posterior Superior Nerve.*

For this technique the same type of syringe with a straight adaptor, short hub and 42 Shimmel needle is used. The most commonly used point of insertion is in the mucobuccal fold opposite the mesial root of the third molar (Fig. 6). The needle is passed upwards, backwards and inwards until it passes the posterior border of the maxilla, where the

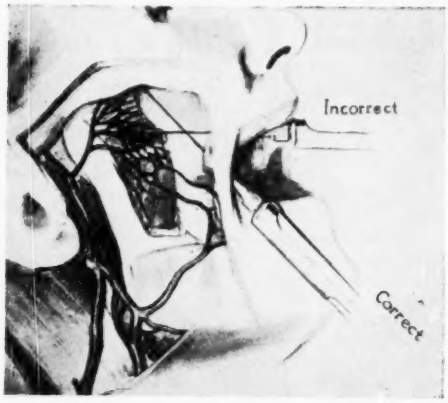

Fig. 7.—The correct and incorrect position of the syringe when injecting the posterior superior nerve.

solution is deposited. Walsh[4] prefers the point of insertion to be in the mucobuccal fold opposite the first molar and, with the fluted edge of the needle against the bone, the needle is passed to the posterior border. This injection is often carelessly given and when the needle is passed too far laterally or too far posteriorly it may enter the pterygoid plexus of veins (Fig. 7) or external pterygoid muscle. In the first case a haematoma will probably result and in the second case probably a trismus will result. In neither case will anaesthesia result.

This technique will anaesthetise the second and third molars for the purpose of conservative dentistry, but requires additional palatal infiltration for surgery or extraction. It will anaesthetise the distal roots of the first molar but additional buccal infiltration is required for conservative dentistry and buccal and palatal infiltration is required for the extraction of this tooth.

(5) *Injection of the Maxillary division of the Trigeminal Nerve.*

This division of the 5th nerve first appears from the skull through the foramen rotundum and then traverses the pterygopalatine fossa. It is in this fossa that we can reach this nerve for the purpose of conduction anaesthesia.

There are three recognized methods of approach, one extra-orally and two intra-orally. Sicher[5] considers the extra-oral approach the simplest, but, as most dentists are reluctant to use it routinely in their dental surgeries, I will confine the discussion in this paper to the intra-oral methods. The first method of approach is the site through the pterygo maxillary fissure to the pterygopalatine fossa. For this method a syringe with the needle set at an angle of 110° to the barrel is used. I prefer to use a glass syringe of the Leur-lok type, with a curved adaptor and a short hub to take an ordinary 42 Shimmel needle of gauge 23 or 24. The point of the needle is inserted into the mucobuccal fold opposite the 3rd molar or in its absence the tuberosity. Keeping the barrel parallel to the occlusal plane of the maxillary teeth the needle is passed upwards, backwards and inwards until approximately 5 mm. of the needle remains exposed. The point of the needle should now be in the pterygopalatine fossa (Fig. 8). With this technique the only resistance the needle should meet is at the first puncture where it passes through the buccinator muscle. Should the needle strike bone early in its passage it is generally the posterior protuberance of the maxilla (which is more pronounced in some skulls than others) which is encountered because the puncture point is too far forward. Should the needle strike bony resistance a little later in its passage it will probably be hitting the greater wing of the sphenoid bone because the needle is too far posteriorly.

Fig. 8.—Hypodermic needle lying within the pterygopalatine fossa.

When the needle is in the right position it is well first to do an aspiration test before injecting the solution in case the needle may have punctured part of the venous plexus. Anaesthesia of the maxillary division should be obtained from the injection of approximately 4 cc. of solution.

The following areas will become anaesthetised after blocking the maxillary branch, including the sphenopalatine ganglion:

(a) Upper lip.

(b) Side of the nose.

(c) Lower eyelid.

(d) Infra-orbital region.

(e) Hard and soft palate.

In some cases anaesthesia will be complete to within a few millimetres of the median line. Usually an overlapping of fibres from the opposite side will cause anaesthesia to be incomplete in the mucous membrane from the midline to approximately the area covering the lateral incisor. It is rare, also, to have complete anaesthesia of the lateral and central incisors. It has been suggested that these teeth receive an additional nerve supply from terminal branches of the opthalmic division of the 5th nerve. These are thought to be twigs from the medial internal nasal branches of the anterior ethmoidal nerve which in turn is a branch of the naso-ciliary nerve.

There are several complications which may arise as a result of technique. If the needle is passed laterally and distally to the pterygo maxillary fissure it may enter the external pterygoid muscle cause trismus and post-operative pain, or it may enter a vein of the pterygoid plexus and cause a haematoma. This can be avoided if the aspiration test is carried out before injection. Of course, no anaesthesia of the maxillary division will result with the needle in this position. If the needle is advanced too far it may pass through the infra-orbital fissure and give rise to anaesthesia of either the lateral rectus muscle, the abducent nerve (6th cranial), or the inferior division of the occulomotor nerve (3rd cranial).

The injection of the lateral rectus muscle or the abducent nerve which supplies it, may cause the eyeball to rotate in a medial, superior or inferior direction, but not laterally whilst injection of the occulomotor nerve will cause dilatation of the pupil. These complications may arise if the solution is forced through the infra-orbital fissure by clumsy injection. Blanching of the facial and palatal tissues may occur due, no doubt, to the action of the vaso-constrictor agent in the anaesthetic solution. No cases of paraesthesia of these nerves are reported. This is no doubt due to the fact that paraesthesia is generally caused by operative trauma which should not occur in this region from ordinary dental operations.

The second method of anaesthetising the maxillary division of the trigeminal nerve is to inject the solution into the pterygopalatine fossa by passing the needle through the posterior palatine canal from the major palatine foramen.

Firstly, the junction of the hard and soft palate is palpated. The posterior palatine foramen will generally be found opposite and very slightly distal to the lingual cusp of the third molar, and about 3 mm. from the junction of the hard and soft palate. Some say the position is 15 mm. from the midline. For this technique I use a Leur-lok syringe with a straight adaptor and short hub for a 42 mm. Shimmel needle. Some prefer a syringe with a curved adaptor. A guide should be used. The depth to which the needle should be passed, according to Jorgenson[6] and others, is 3 mm. less than the distance from the infra-orbital margin to the gingival margin of the bicuspids. This can be measured by the use of a needle gauge or by some suitable material as gutta percha, or rubber dam.

The needle is inserted and a few drops of solution injected, then the foramen may be sought without causing pain. Usually it is not hard to find. The needle is then passed up the canal at an angle of approximately 60° to the occlusal plane of the maxillary teeth, the barrel of the syringe occupying a position over the lower canine on the same side (Fig. 9). From this position the needle is passed into the pterygopalatine fossa which the maxillary nerve traverses as previously pointed out. As with the first method it is well to do an aspiration test before injecting the solution. Symptoms of anaesthesia are the same as for the first method.

Fig. 9.—Anaesthetisation of the maxillary division of the trigeminal nerve by injection through the posterior palatine canal.

Szerlip[7] advocates the use of this technique and Corbett and Helmore[8] report that after observing the results of some 200 injections they found no contra-indications for this technique.

There are certain advantages to this technique. Firstly, there should be no fear of

entering the cranial cavity because, as a rule, if the needle passes too far it should strike bone, either the medial pterygoid plate or the inferior surface of the greater wing of the sphenoid bone. Orbital complications will only arise from the overflow of anaesthetic solution as mentioned in the first method.

Secondly, the technique is not really difficult as the needle passes by the shortest route to the pterygopalatine fossa and there is a certainty of landmarks. The needle is either in the canal or it is not. If it is so far posterior that is passes the posterior border of the hard palate, it will first pass straight through the soft palate. If the solution is injected it will only spray the posterior wall of the naso-pharynx and most patients usually react immediately. On withdrawing the needle the patient will probably cough up some of the solution not swallowed and blow the rest out of the nose. Thirdly, this technique avoids the possibility of a haematoma as the puncture avoids the pterygoid plexus of veins as well as the possibility of injecting into the buccal pad of fat.

Finally, when swelling exists it is usually on the buccal side of the bony structure and the injection can be made well away from the infected area.

There are some disadvantages to this technique, however. The canal in some cases may be tortuous and prevent easy passage of the needle, or in some cases may not open as a single canal. Both these are rare and therefore the position seldom arises. Also, sudden movement by the patient may cause the fracture of a needle, but it usually fractures at the hub and there should be some of the needle remaining exposed. With sufficient care, and the avoidance of force, no damage should be wrought upon the soft structures within the canal. This technique is contra-indicated in very nervous adults and in very young children, in cases where a trismus exists, or infection or inflammation is present in the palatal region of the upper second or third molars.

(6) *Injection of the Mandibular Branch of the Trigeminal Nerve.*

Time does not permit in this talk to discuss mandibular block anaesthesia. However I would like to mention the question of prolonged anaesthesia in relation to this type of injection. The length of time of anaesthesia does not matter a great deal with most injections so long as the vaso constrictor does not retard the blood supply to an extent that will jeopardise normal healing after operation. With the mandibular block, however, prolonged anaesthesia may cause the patient to damage the lower lip (Fig. 10). It is as well to advise the patient and in particular parents of children of the dangers of lip biting after a mandibular block.

Fig. 10.—Injury caused to the lip by chewing whilst it was anaesthetised by a mandibular block injection.

Contra-Indications to Use of Local Anaesthesia.

Archer[9] lists the following contra-indications for the use of a local anaesthetic.

(i) The presence of acute suppurative infections where the needle insertion area is involved.

(ii) The presence of periodontal conditions, such as pericementitis, which may render the anaesthesia imperfect.

(iii) Extreme youth, as very young children are below the age of reasoning and understanding.

(iv) Neurasthenia, apprehension or lack of co-operation in patients who cannot be controlled by pre-anaesthetic medication.

(v) Ankylosis and trismus, when the patient's jaw cannot be opened sufficiently and the extraoral route is inadvisable.

(vi) The establishment of drainage in patients with facial brawny, indurated submaxillary or cervical cellulitis.

(vii) Systemic conditions such as hyperthyroidism when the epinephrine contents of the local anaesthetic solution might precipitate a thyroid crisis.

(viii) Idiosyncrasy to procaine.

(ix) Hepatitis.

(x) Cardiovascular diseases *unless* the patient has been well premedicated with one of the barbiturates. In such cases there should not be any epinephrine in the anaesthetic solution.

Conclusion.

Armed with these techniques, each of which has its use in the proper place, and observing the cardinal rules of asepsis, there is no reason why the general practitioner should not be able to work painlessly. A general practitioner should not limit himself to only some of these techniques.

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The Principles of Design of Removable Appliances for General Practice*

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Introduction.

In Australia there is a growing demand for children's dentistry, particularly for orthodontic treatment. Adamson has pointed out that 50% of Melbourne children require orthodontic treatment but, while the demand for it has increased, there has not been a corresponding increase in facilities for satisfying the demand. The cost also is such, particularly when fixed appliances are used, that a large percentage of the patients are excluded from treatment.

There are two ways in which this problem may be overcome: firstly, the number of fully trained orthodontists could be increased or, secondly, the existing methods of treatment could be simplified.

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The report of the Committe of Education of the American Association of Orthodontists recommended that 300 hours should be allotted for undergraduate teaching and that only the fundamental principles should be taught. This means that upon graduation a dentist will not have sufficient training to attempt orthodontic treatment of any kind and further study will be required to produce capable orthodontists. Hence this first suggestion provides no short term solution.

The second suggestion has more merit as simplification of treatment could mean that a greater number of patients could be treated in a shorter time by fewer operators and the cost of treatment would be less.

In order to simplify orthodontic treatment it is necessary to acquire a better understanding of the basic problems associated with orthodontic treatment. The abundance of different appliances and the numerous and often contradictory theories concerning treatment which have often arisen from the use of empirical methods have led to much confusion. Such trial and error methods are due mainly to a neglect of the fundamental principles of orthodontic treatment.

A partial solution to the problem of simplification may lie in the development of removable appliances and this paper is a preliminary analysis of the problems associated with the design of such appliances and their use. The question of diagnosis and the possible pitfalls of treatment will not be considered here.

Design of Removable Appliances.

Orthodontic treatment usually requires the movement of teeth through bone. To do this, a force is applied to the teeth and movement is expected in the desired direction. If the teeth do not move in that direction the treatment is considered unsatisfactory and the plan of treatment changed.

Since the orthodontist determines the design and selects the materials used in the appliance, he is responsible for the degree of force exerted by the appliance. However, the estimation of this force has in the past been often neglected with unfortunate results. It has been shown that, if too great a force be applied to a tooth, the anchor teeth, rather than remaining stationary, move further than the tooth it is desired to move[1, 2]. If lesser force is used within a limited range the required movement can be brought about rapidly without movement of the anchor teeth. Such forces are much smaller than those which are being used at the present time. This means that, if forces within a limited range of values are used, anchor units can be designed which will not move appreciably during treatment.

Not only does the degree of force influence the rate of movement of teeth but also the changes seen in the bone. Radiographic[3] and histological studies show that there is a great difference in the response of bone to heavy and light forces. When heavy forces are used bone is not laid down in front of, or behind, a moving tooth and clinically the tooth becomes loose (Fig. 1). On the other hand bone is laid down behind and in front of a moving tooth if light forces only are used (Fig. 2). Thus if we apply constant and controlled forces to teeth we know that their movement will occur at certain rates depending upon the degree of force applied.

Fig. 1.—Radiograph illustrating the appearance of the bone surrounding a cuspid tooth which has been moved distally by means of a heavy force: *a* shows that there has been very little bone laid down on the tension side while at *b* on the pressure side there has been little increase in the density of the bone; *c* shows a radiolucent area on the tension side from which the movement of the apex of the tooth was measured.

Fig. 2.—Radiograph of an upper cuspid tooth moved distally by means of a light force: *a* indicates a radiolucent line which marks the position of the original lamina dura; *b* shows the position of the lamina dura before movement was commenced; *c* indicates the trabeculae of the newly formed bone, orientated in the general direction of the applied force; *d* shows that dense bone has formed on the pressure side.

These facts are important when designing removable appliances. In such treatment any force applied to the teeth by springs tends to displace the appliance from the mouth. If large forces are used the appliance tends to fall out of the mouth and the patient cannot or will not continue to wear it.

To improve the stability of the appliance in the mouth clasps are used for retention. One type of clasp which has been of great value is that described by Adams[4]. It is obvious that the greater the area over which the appliance is constructed the greater its stability, i.e. the more teeth used for anchorage the less the danger of movement of the appliance. However, if the force applied by the springs is too great then the appliance falls out of the mouth despite the retention from the clasps. But, if the retention is such that the appliance remains in position, then movement of the anchor unit occurs, usually accompanied by complaints from the patient that the appliance is cutting into the lingual tissues.

Fig. 3.—An illustration of the helical-torsion spring placed in such a position that, when force is applied, the incisor tooth will move laterally.

As retention depends upon the degree of force tending to dislodge the appliance, it has been found necessary arbitrarily to limit the maximum force exerted by springs to 200 gm., i.e. no matter how many springs there are in use at the one time the total force must not exceed 200 gm. This means then that in designing the springs small forces are used which can be controlled by the orthodontist and yet will function efficiently in a child's mouth without fracture or permanent distortion. The type of spring chosen is the helical-torsion spring (Fig. 3). This consists of a free arm with a number of loops wound into one end which is attached to the denture base. These springs can be so designed that they exert light controllable forces, the degree of force exerted depending upon the factors shown in the following expression:—

$$P \propto \frac{D^4 \; E}{L^2 \; NR} \delta$$

where P = the force.
R = the radius of the loops.
L = the length of the free arm.
D = diameter of the wire.
E = elastic modulus.
δ = deflection.

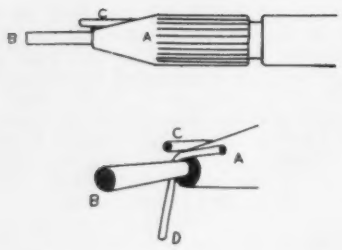


Fig. 4.—Diagram illustrating the spring winder: *A*—the scaler handle; *B*—the bur inserted into the scaler handle. The diameter of this bur has been reduced to .05"; *C*—arm soldered on to the scaler handle to hold wire when forming a spring; *D*—illustrates a wire in the process of being bent in the form of a spring.

To try and use this expression to determine the force exerted by each spring would not be practicable but it is possible to standardise a number of the variables. As stainless steel of the same quality is used, "E" (the elastic modulus) remains constant and may be disregarded. The use of a standard spring winder means that the diameter of the loops is constant, while the space available in the mouth limits the number of loops to 2½. (A spring winder can easily be made from a scaler handle on to which a small arm has been soldered. A mandrel, formed from a bur, is inserted backwards into the scaler handle. The wire is then held firmly while the scaler handle is twisted (Fig. 4). This very simple device was introduced by Newbury of Melbourne.) The deflection has also been standardised at 3-4 mms. so that the patient may place the springs into the correct position in the mouth without undue effort. As most of the factors have thus been standardised, the force exerted depends on the two factors remaining in the expression, i.e. D and L.

$$P \propto \frac{D^4}{L^2}$$

This means that the longer the arm of the spring the less the force applied and the greater the diameter of the wire the greater the force applied. The length of the free arm is determined by the available space within the mouth, i.e. the position of the arm of the spring in relation to the teeth to be moved.

The Positioning of the Spring.

When the free arm of a helical-torsion spring moves it describes an arc with the axis at the fixed end of the spring embedded in the material of the appliance.

As a general rule the fulcrum point should be placed at right angles to the required line of movement, i.e. half way between the original position of the free arm (before movement of the tooth has taken place) and the final position of the tooth when the desired movement has been completed. Also the spring should be placed so that the free arm traverses an arc without gingival or occlusal movement so that it neither irritates the gingivae nor slips off the tooth.

How far should the fulcrum point be situated from the tooth? Here again the available space in the mouth determines the size and shape of the spring. Should the arm be so short that the force is delivered over a distance of, say, 3-4 mm., it will be quite great. To lessen the force it would be necessary to reduce the diameter of the wire to such an extent that the possibility of fracture would be very high. If the arm is longer very small forces would be applied. However, the long arm would be subject to distortions and could interfere with movements of the tongue. Obviously a compromise between these two positions is necessary.

In practice the springs have been standardised in three sizes (Table I) and deliver forces of approximately 75-100 gm. over a deflection of 4 mm.

If standard springs of known dimensions are used then it follows that standard forces will be applied and it will not be necessary to measure each spring to determine the force applied. In practice it means that the design of springs has been simplified to such an extent that any dentist may use controlled forces of known values. It could also mean that orthodontists will be able to communicate their information in precise terms to other members of the dental profession who should then be able to obtain similar results by using the same forces.

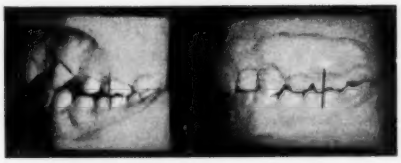
TABLE I.

THE DIMENSIONS OF THE THREE TYPES OF SPRINGS.

Type of Spring	Diameter of Wire	Length of Arm of Spring
1	.020"	½"
2	.024"	¾"
3	.028"	1"

Cases Which Illustrate the Use of Helical-Torsion Springs.

These cases illustrate some of the various types of movements which may be carried out by using these springs although type 2 is regarded as the basic spring. If the arm of this spring is lengthened or shortened then types 3 or 1 should be used. It should be emphasised that these models only illustrate the types of movements which may be carried out.



(a) Before. (b) After.

Fig. 5.—Models of a case before and after the distal movement of the upper cuspid teeth followed by the lingual movement of the incisor teeth.

Case 1. Figure 5 shows the models of a case before and after the distal movement of the cuspid and incisor teeth. After the distal movement of the cuspid teeth, the incisor teeth were moved distally using a latex band formed from drainage tubing of $\frac{3}{16}$in. diameter. The elastic band may either be hooked around the existing cuspid retraction hooks or around hooks which also function as clasps (Fig. 5(b)). The anterior part of the denture lingual to the incisor teeth is removed to allow movement of the teeth.

Case 2. In certain cases of malocclusion the condition of the first molars necessitates their extraction although the bicuspid teeth are those of preference. The distal movement of the cuspid, first and second bicuspids may be obtained by using springs applied to the mesial of the cuspid teeth. In all cases where cusp interference may occur during the movement of teeth it is necessary to add a bite platform to the acrylic denture base so that the bite is opened. Following the retraction of the buccal segments the incisor teeth may be moved lingually in the manner shown previously.

Case 3. The premature extraction of deciduous teeth usually results in the mesial migration of the first molars which prevents the eruption of the bicuspid teeth and leads to some form of malocclusion. When this happens a removable appliance can be construced which will move the molar teeth distally and bicuspid teeth mesially on either the upper or lower jaw.

(a) Before. (b) After.

Fig. 6.—Models of a case before and after the movement of the lower first bicuspids mesially and the lower first molars distally. The lower second bicuspids are in the process of eruption into the space created.

Figure 6 illustrates one example showing the distal movement of molar teeth and mesial movement of bicuspid teeth on the lower jaw. The arm of the spring should not be placed too far gingivally because the shape of the crown presents with a slight incline which tends to direct the arm of the spring gingivally. When using these springs on the lower jaw it may become necessary to decrease the length of the arm of the spring and as this results in an increase of the applied force it is preferable to decrease the diameter of the wire, i.e. to use spring type 1. On the upper jaw, spring type 2 should be used.

Case 4. The rotation of teeth with removable appliances is not simple. However, central and lateral incisor teeth on the upper jaw may be rotated by using two springs: a labial wire of .028in. diameter which guides the mesial edge of the tooth into its correct position while a lingual spring type 1 or 2 applies force to the distal edge of the tooth. Here again it should be emphasised that very light forces, below 50 gm. if possible, should be used in this particular type of case. The force can be reduced quite simply by decreasing the deflection, i.e. instead of activating the arm of the spring 3-4 mms., only activate it 2 mms.

(a) Before. (b) After.

Fig. 7.—Models of an early Class III (Angle) case of malocclusion before and after movement of the four upper incisor teeth.

(c) (d)

Fig. 7 (c).—Diagram showing the positioning of the two springs.

Fig. 7 (d).—Diagram showing positioning of the two springs in order to move buccal segments laterally.

Case 5. Figure 7 (a) and (b) shows the models of an early Class III (Angle) case of malocclusion before and after treatment. Two

springs (type 3) were used to move the incisor teeth labially. The position of the springs is shown in the diagram (Fig. 7 (c)). The early Class III in the deciduous dentition can also be treated in the same way in conjunction with a headgear which is worn at night. In the deciduous dentition it is preferable to use only .020in. diameter wire so that the force is decreased to a very low level.

Similarly upper buccal segments may be moved laterally in both the deciduous, mixed and permanent dentitions using the arrangement of springs as shown in figure 7 (d). In this type of case the force exerted is of great importance as the retention is decreased due to the number of teeth moved at the one time. This is done by only activating the arms of the springs 2-3 mm. instead of 4 mm.

(a) Before. (b) After.

Fig. 8 (a) and (b).—Models of a case before and after the distal movement of the upper buccal segment on the left side.

(c) Before. (d) After.

Fig. 8 (c) and (d).—Models of the same case before and after the distal movement of the upper buccal segment on the right side.

Case 6. Spring first pointed out to the author that the upper first and second bicuspids and second molar teeth could be moved distally using a spring applied to the mesial edge of the first bicuspid. The distal movement of buccal segments without the extraction of teeth is sometimes also necessary and may be achieved in the same way in certain selected cases. Figure 8 (a) and (b) show the left side of an Angle Class II division II case of malocclusion before and after distal movement of the upper left bicuspids and molars. The unerupted cuspid has now erupted into the space created. Figure 8 (c) and (d) show the other side of the same case before movement of the buccal segment and illustrates that there has been no mesial movement of the mandible during the distal movement of the opposite segment. The model in figure 8 (d) shows the distal movement of the right buccal segment. If the force used to perform this movement is too great then mesial movement of the incisor teeth may occur.

The success of removable appliance treatment depends ultimately upon the patient's co-operation which, if not obtained, can lead to unforeseen results. This point has been taken into consideration in the design of these springs, i.e. with respect to the degree of activation used. The first helical-torsion springs were designed to be deflected about 8-10 mm. and to apply light continuous loads.

In one particular case the space required for the eruption of the second bicuspid tooth had been lost by mesial migration of the upper first molar tooth. An appliance was inserted which was designed to move the bicuspid and molar teeth apart. The patient then failed to report for treatment for 12 weeks. When the patient reported again for treatment an excessive opening of the space of 5 mms. was present while the upper second bicuspid had erupted during the intervening 12 weeks. The appliance was removed and the case eventually relapsed back in to normal occlusion.

On account of this and similar incidents it was decided to limit the activation of the springs to 3-4 mms. so that the movement of teeth could never exceed that required: an important design consideration in removable appliance treatment which must be recognised is the unpredictable behaviour of patients.

In conclusion it is hoped that this method of approach, i.e. the use of standardised ranges of force can help to simplify the problem of treating large numbers of cases of malocclusion and also that this will in some way help to extend the range of cases which the general practitioner can treat successfully.

ACKNOWLEDGMENTS.

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Occlusal Guide Plane*

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We have tried in this paper to combine the theories and experiences we have accumulated over a period of years in the use and application of the occlusal guide plane as an auxiliary to labiolingual technique. No attempt has been made to criticize any other technique but merely to state our results.

The occlusal guide plane has been defined as a mechanical device having an established inclined plane which, when in use, causes a change in the occlusal relation of the maxillary and mandibular teeth and permits their movement to a normal position. The purpose of the occlusal guide plane is to obtain a change in the structural relation of the oral cavity and to aid in the establishment of a correct anterior-posterior relation of the teeth and arches. We know that the occlusal guide plane is a fixed removable appliance which has a decided advantage over the ordinary type in that the patient cannot put it in or take it out at will. It is constructed on a maxillary lingual appliance so that the mandibular incisors do not engage it forcefully, but are guided anteriorly to the plane when the jaws are brought together. The occlusal guide plane should rest on the lower lingual appliance or be slightly anterior to it and touch the lower lingual appliance from cuspid to cuspid when the teeth are in occlusion. In most cases in which bite opening is indicated, the molars and premolars will be out of occlusion when the appliance is first placed on the teeth. When constructing the occlusal guide plane, the relation of the mandible and the maxilla is set to a determined position permitting the premolars and molars to meet in what is known as normal occlusion. This point at which the mandible is place is a position of mechanical advantage, and the occlusal guide plane is constructed to hold this point on closure of the jaws.

The greatest advantages of the occlusal guide plane are that it permits freedom in tooth movement and does not load the teeth with bands. Mershon has said than any appliance or procedure that limits the slight movement which is natural with teeth impairs the tooth function. In changing the anterior-posterior relation of the mandible and the maxilla, we also change the incisal relation. The pitch or variance from perpendicular of this auxiliary is determined primarily by the change of anterior-posterior relation of the arches, and secondarily by the amount of occlusal separation between the maxillary lingual appliance and the mandibular lingual appliance. The incline of the plane is not made in a hit-or-miss fashion, but is built to precision. It may have a slight forward or backward inclination to conform to the individual case. The depth of the plane will vary with each individual case, and will be governed by the pitch and amount of space between the maxillary lingual appliance and a position where it will strike the mandibular lingual appliance. In some cases it might even touch the cuspids or lower anterior teeth slightly at the gingival margin. By changing the incisal as well as the occlusal relation, nature is free to let the teeth move into their respective positions. If the appliance is constructed properly, the patient cannot bite posterior to the occlusal guide plane but will be guided to only one point of rest when the teeth are in full occlusal position. The occlusal guide plane must be constructed on a maxillary lingual that will *not form* a pointed curve but rather a squared curve at the cuspids. This should not be overdone, however. A poorly constructed lingual appliance as a foundation causes the plane to dig into the tissue. The lingual appliance should hug the premolars as much as possible. We do not intend to go into detail on its construction at this time as this is adequately covered in the book, "Labio-Lingual Technic."

The idea of the occlusal guide plane is not new by any means and was probably begun many years ago by Duval, Fox and Delabarre when they constructed various appliances to change the bite. We use the term occlusal guide plane, but not in the real sense of the word as we know it today, because it, like anything else, has gone through various stages of development. These premature attempts at constructing an occlusal guide plane were in reality nothing but inclined planes. An inclined plane is defined as "some form of plate which the mandibular incisors forcefully engage in closure." It seems that the earliest inclined planes were used only to release the lingual lock of the maxillary anterior teeth. Kingsley seems to have been the first to use the inclined plane on the maxilla to change the anterior-posterior relation of the jaw, and was inseverably associated with "jumping the bite." He was also apparently the first to use the inclined plane on Class II or distocclusion cases. From the time of Kingsley to that of Hawley various types of planes were constructed, but all of

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them failed because their results could not be permanent. After the bites were changed they could not be made to stay there. In 1919 Oliver constructed a plane with the same idea in mind as the other men had had, that of changing the bite. His first plane had no definite height or pitch and in reality was the same as had previously been made except that precious metal was used in its construction. Using this particular plane he realized that some change had to be made in order to get a surer movement and a more permanent one. This he accomplished in 1923 with his next design of the occlusal guide plane by constructing it from lateral to lateral and extending down to the lower lingual appliance. The next major change in the occlusal guide plane was to extend it laterally to the centre of the cuspids; through this step the patient could not move laterally and had only one position of closure. Fifteen years after the first construction of the occlusal guide plane, it was described and discussed in detail in the textbook, "Labio-Lingual Technic."

There are definite limitations regarding the use of the occlusal guide plane, and we should adapt the appliance to the condition rather than the condition to the appliance. Important as any appliance may be in orthodontic treatment, the judgment and experience of the operator are the deciding factors. Correct selection and application still determine the success or failure of the most perfectly constructed appliances.

Oliver recognized in his experiments with the occlusal guide plane that it was a definite adjunct to labiolingual technique. Nearly all cases which have been classified as Class II, Division I types of malocclusion, in which it is desirable to re-position the mandible forward in relation to the maxilla, are indications for the use of the occlusal guide plane. Since this appliance guides the mandible forward, on occluding, caution must be exercised in extreme cases not to set the mandible too far forward permitting the patient to be guided posterior to the plane rather than in front of it. In some extreme cases many guides are constructed successfully, each permitting the mandible to move forward a little more each time. Intermaxillary elastic bands are an ideal supplement to the treatment of this type of case. These cases are improved immediately, thus encouraging the patient to co-operate to the fullest of his or her ability.

Another type which nearly always is treated successfully by the occlusal guide plane is that of Class II, Division II. Here the maxillary incisors are retruded to such an extent that it may be necessary to move these teeth forward before placing the occlusal guide plane. In these cases in which the plane may be used from the beginning, it is a definite asset in moving the maxillary anterior teeth to a normal position.

A third indication for the use of the occlusal guide plane is the treatment and correction of cases falling into the subdivisions of Divisions I and II of Class II. The condition to be treated is that of a unilateral distoclusion with the same characteristics as the respective divisions.

Certain Class I cases with a closed bite can be treated successfully, but care should be used in selection and success is accomplished by the depression of the anterior teeth as well as the elongation of the posterior teeth.

The use of the occlusal guide plane is contraindicated in nearly all other types of cases not mentioned previously. Especially is it contraindicated in Class III, and in open-bite cases. As in selection of any type of appliance, diagnosis and judgment must be exercised.

We are often confronted with the problem of extraction. There is nothing new about the idea, for back in 1757 Bernard Bourdet advocated the extraction of two maxillary premolars to allow room for the canines to erupt. Later Dewey and Case argued over this same question. We all must keep a level head in this matter and consider each case individually throughout the treatment. Surely we would not practice extraction in 95 per cent. of our patients if we considered other factors as important as that of a perfect alignment. If the extraction of four permanent premolars in a Class II case is indicated, the occlusal guide plane will still produce a satisfactory result.

We have all been groping for quite some time trying to figure out just what happens when bites are changed. Brash, Schour, and Brodie, who have given us some valuable information on the growth of the mandible, found that growth occurred, in general, throughout the mandible until the eruption of the first permanent molar. Thereafter, growth was restricted to the posterior borders of the rami, the alveolar process, the border of the sigmoid notch, and the head of the condyle. Vertical growth is confined to additions in the alveolar process and the upward growth of the heads of the condyles against a plane that is descending. Therefore, the mandible is forced downward. The condyles are apparently the growth centres that retain their activity the longest, for they must act as the compensating factors that take care of all the vertical growth processes of both mandible and maxilla.

Fig. 1.—Model indicating jaw relation of patient (right side).

Fig. 2.—Model indicating amount of "set up" or forward movement desired. Note lines drawn through maxillary cuspids and extending to mandibular model (right side).

Fig. 3.—Proper construction of mandibular lingual appliance.

Fig. 4.—Proper construction of maxillary lingual appliance for this particular case.

Fig. 5.—Correct height of occlusal guide plane.

Fig. 6.—Finished and soldered reinforcing on occlusal guide plane.

Fig. 7.—Finished occlusal guide plane.

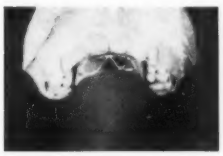

Fig. 8.—Finished occlusal guide plane.

Fig. 9.—Springs added to plane for expansion of maxillary arch.

The growth in the body of the mandible of most of our patients has already been completed when they are placed under treatment. Therefore, when the bite is changed and the posterior teeth are elongated, we cannot get our change in the body of the mandible but must be getting it in the alveolar process to some extent and also in the head of the condyles where growth is active until adult life.

The question of whether any pathology has been created in the condyle area has also been asked by those using the occlusal guide plane as well as those not using it. Costen has proved conclusively that close-bite cases and those with the retruded mandible are definitely responsible for neuralgia in some of the older patients. When the bites were opened and correction was under way, this neuralgia ceased.

Lunsford, Terry, and others have made scientific investigations to determine exactly what change has taken place, if any, in patients treated with the occlusal guide plane. This is being carried out by obtaining a series of case histories with models and x-rays of the temporomandibular articulation both before and immediately after placing the occlusal guide plane. Later a series of follow-up x-rays were taken during, after, and then, when possible, several years after treatment time. Progress has been slow but some definite findings have been made. When the occlusal guide plane is placed in the patient's mouth, the condylar head is pulled downward and forward out of the glenoid fossa, but later x-rays indicated that after movement of Class II cases using the occlusal guide plane, the condylar head is again in the glenoid fossa in a normal relation. Terry and Lunsford have been carrying on this experiment for about three years. There was no evidence of pathology in cases investigated at any time insofar as it has been possible to determine.

The return to normal in the temporomandibular articulation undoubtedly stimulates growth in the head of the condyle, for this remains an active growth centre of bone until the patient reaches adulthood. Since nothing is stationary or static, other adjustments probably occur in the glenoid fossa. We feel that the movement and change definitely lie in physiologic limits and have been demonstrated clinically for many years. If this growth or change at the head of the condyle is not pathologic but is a physiologic change, we will have no relapse of the bite. This appliance has succeeded in locking the bite where others have failed by the ability to limit the bite to only one point of closure. When we fail to get our results, we should remember that it is not the failure of the appliance but more often the fault of the operator in his diagnosis and application of the appliance.

We would list the advantages of the occlusal guide plane as follows:

1. Immediate changing of the bite, which allows the intermaxillary rubber bands to work from a determined point, thus cutting down treatment time.
2. Opening of the bite, permitting vertical growth and unlocking of the cuspids.
3. By placing the arches in normal position immediately, the patient is given benefit of normal muscular action and gaining more room for the tongue and passages of air.
4. Fixing the bite at a definite place rather than letting the patient bite behind, on, or anterior to the appliance as can be done with other inclined planes.
5. It immediately changes the profile to a pleasing one, thus encouraging the patient to wholehearted future co-operation.
6. It is simple though sturdy in design, and is easily removed, adjusted, and replaced by the operator.
7. It can be used on all types of dentition.
8. It balances the anterior-posterior relation of the jaws as well as the incisal relation, an objective which must be accomplished if functional retention is to be realized and maintained.

Of course, in all of the uses of the occlusal guide plane, as it is with any other appliance, some degree of common sense and application is necessary. Let us all fit the appliance to the condition rather than fit the condition to the appliance.

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The Early History and Later Development of General Anaesthesia with Reference to Dental Practice*

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The early history of general anaesthesia is closely linked with two members of the dental profession. The first, Horace Wells, dentist of Hartford, Connecticut, died in 1848 at the early age of 33 years, but four years before his death, for the first time in history, he used nitrous oxide as a general anaesthetic for dental extractions. The second, William Thomas Green Morton, another dentist, was born in 1819 and died in 1868. In 1846 he successfully demonstrated ether as a general anaesthetic to the surgeons of the Massachusetts General Hospital.

*Read at the 13th Australian Dental Congress, Brisbane, June, 1953.

In December, 1844, Wells saw the following advertisement posted upon the walls of the town of Hartford:—

A Grand Exhibition of the effects produced by inhaling Nitrous Oxide, Exhilarating or Laughing Gas! will be given at Union Hall this (Tuesday) evening, December 10th, 1844.

Forty gallons of gas will be prepared and administered to all in the audience who desire to inhale it.

Twelve young men have volunteered to inhale the gas, to commence the entertainment.

Eight strong men are engaged to occupy the front seats to protect those under the influence of the gas from injuring themselves or others. This course is adopted that no apprehension of danger may be entertained. Probably no one will attempt to fight.

The effect of the gas is to make those who inhale it either laugh, sing, dance, speak or fight, and so forth, according to the leading trait of their character. They seem to retain consciousness enough not to say or do that which they would have occasion to regret.

N.B. The gas will be administered only to gentlemen of the first respectability. The object is to make the entertainment in every respect a genteel affair.

This demonstration was preceded by a short lecture and was staged by an itinerant pseudo-scientific lecturer named Colton, who made his living by travelling up and down the States of America giving entertainments of this nature.

On this occasion Wells was present, and together with others he requested Colton to give a private demonstration on the following morning. At this demonstration one of the audience, whilst under the influence of the anaesthetic, ran against and overturned several settees in the hall, badly bruising his knees and other parts of his body. After recovery this man said that he had felt no pain, although severely bruised; Wells remarked that

. . . . . he believed that a person could have a tooth extracted while under its influence and not feel any pain,

and he persuaded Colton to administer an anaesthetic to him while another dentist extracted the tooth. The experiment was completely successful.

Realising the enormous benefit of painless extractions, Wells learnt from Colton how to make the gas and during the ensuing four weeks had performed 15 painless extractions. Through Morton, Wells arranged a demonstration. Unfortunately, the demonstration was unsuccessful and Wells did not pursue the matter. He became ill soon afterwards, dying four years later.

Nitrous oxide was forgotten as an anaesthetic until 1864 when Colton, who still gave lectures and demonstrations as before, was asked by a lady in his audience to administer the gas to her for the extraction of teeth. The anaesthetic was successful and the dentist

who extracted the teeth was so impressed that he adopted the method and, in the course of the next 12 months, gave satisfactory anaesthetics to more than 600 patients.

Using Colton's method, nitrous oxide gas was prepared in the surgery by heating granulated ammonium nitrate in a retort, passing the gas evolved through a series of wash bottles to remove impurities, and thence to a gas holder. From the holder ran a length of tubing terminating in a mouthpiece through which the patient breathed nitrous oxide directly from the gas holder. However, by 1868 it was being produced commercially, being compressed into metal cylinders. The cylinder fed the gas into a reservoir which stood in a corner of the dentist's surgery.

Morton, although interested in the experience of Wells and the idea of painless extractions, felt that a more reliable agent than nitrous oxide should be found. In 1844 liquid ether had been suggested to Morton as a local anaesthetic by a chemist named Jackson. He deliberately experimented with it, upon his dog, himself, and upon two of his apprentices. The outcome of this was that in 1846 a patient allowed himself to be etherised for the extraction of a tooth. Morton saturated a handkerchief with ether, made the patient breathe through it until he was asleep, then performed the extraction; the anaesthesia was quite successful.

The type of apparatus was a glass globe open at the top and with a brass tube and mouthpiece projecting from the side; a sponge soaked with ether was inside the globe and the patient breathed through the mouthpiece; simple flap valves ensured that inspirations would come in through the globe while expirations escaped to the atmosphere without re-entering the globe.

Whereas in the days of Morton, anaesthetics for dental operations were rarely of any length, today operations may require considerable time and skill, demanding a very high standard of general anaesthesia to facilitate the task. Many major dental operations such as extractions followed by extensive alveolectomy, removal of impacted third molars, unerupted teeth, cysts of the alveolar process, all require specialised general anaesthesia for the patient's safety and the operator's ease of working.

The anaesthetic problem is to maintain adequate general anaesthesia, with a perfect airway throughout, safeguarding the bronchial tree from invasion by blood, mucus, tooth fragments, vomitus, or any other foreign body, and yet leave for the dental surgeon good access to the oral cavity, unimpeded by anaesthetic apparatus. The mouth is a very confined space in which to work, so that the fulfilment of these requirements is no mean task.

Recently an experiment was carried out in order to discover how much blood and foreign matter entered the bronchial tree from the mouth during multiple extractions under nitrous oxide anaesthesia, with the patient sitting upright in a dental chair. The method adopted was to soak the sponges used as mouth packs with LIPIODOL (a radiopaque oil) and x-ray the patient's chest after the operation. Any LIPIODOL which had entered the trachea and bronchi could be seen in the x-ray. A very large percentage of cases showed that this foreign material had in fact, gravitated down between the vocal cords and it was argued, therefore, that blood and mucus (or, if the mouth packing was inefficient, tooth fragments, dislodged fillings or chips of alveolus) could enter the trachea with great ease with the patient sitting upright and with this type of anaesthesia. For this reason this method of anaesthesia is not ideal, in addition to the fact that satisfactory anaesthesia is difficult to maintain with nitrous oxide and oxygen through a nasal mask for a long time. Further, throughout this time the operator has to maneouvre round a mouth prop and nasal mask. In addition, the maintenance of a free airway requires constant care, obstruction being readily produced by a variety of circumstances such as sponges pushing the tongue against the posterior wall of the pharynx, excessive depression of the mandible by the operator's hand or by too large a mouth prop. Partial obstruction may not be dangerous to the patient for a very short time but it produces a rise in blood pressure and venous engorgement which can cause excessive bleeding, thus obscuring the field of operation. Death can occur during the anaesthetic from complete obstruction, or it may occur later as a result of atelectasis, pneumonia, or lung abscess. Also, the dire results of foreign bodies entering the lower air passages need no emphasis.

As long ago as 1869 Trendelenburg, a German surgeon, concluded that operations on the larynx and the buccal and pharyngeal cavities should be preceded by tracheotomy after first anaesthetising the patient, anaesthesia being maintained via the tracheotomy tube and the larynx being packed off. For this purpose he used a cone connected to the tracheotomy tube by a rubber tube; over the large open end of the cone was stretched thin flannel on to which chloroform was dropped. This method would

be rather heroic for even the most serious dental operation, but it was the beginning of the solution of our problem today.

In 1847 MacEwen, a Glasgow surgeon, passed a tube through the mouth into the trachea to preclude haemorrhage from the larynx and for the administration of the anaesthetic, during the removal of an epithelioma from the pharynx and base of tongue. He accomplished this by introducing a finger into the mouth, depressing the epiglottis on the tongue, and so guiding the tube over the back of the finger into the larynx. However, the methods used to overcome anaesthetic difficulties in oral surgery went through many vicissitudes before orotracheal and nasotracheal tubes were introduced by Magill in 1921 and before the direct vision laryngoscope was invented.

Ivan Magill, a British anaesthetist working in London, popularised what is universally known as the Magill Tube for intratracheal anaesthesia. These tubes are of curved rubber and are made in 12 different sizes to accommodate patients ranging from the newborn infant to large men. The end which is inserted between the vocal cords is cut across at an angle of 45°. Orotracheal tubes are of harder rubber than the nasotracheal tubes so that they are less easily compressed or kinked; the nasotracheal variety are soft so that they are less likely to damage the delicate vascular mucous membrane lining the nose, through which the tube has to be passed into the pharynx and larynx. Orotracheal tubes may have an inflatable cuff at the end to be inserted between the cords so that an airtight and watertight seal may be created between the outside of the tube and the inside of the trachea, the tube virtually becoming an extension of the trachea connected with an anaesthetic machine.

The tube selected should be as large as the open cords can comfortably accommodate. The nasotracheal tube is necessarily restricted in size by the nasal aperture but breathing through these tubes is effortless if the size is well selected.

If the surgery to be performed is restricted to one side of the mouth, a cuffed tube may be passed and adjusted to lie in the opposite angle of the mouth; the cuff is inflated and the patient's airway rendered quite safe. A pharyngeal pack is inserted to prevent blood from entering the stomach which would cause the patient to vomit later; a sucker is then used primarily for convenience. However, generally speaking the nasotracheal tube is most suitable as it leaves the dental surgeon with an unrestricted field in which to work; as the tube is not cuffed, a large gauze ribbon pack is inserted into the pharynx and is packed round the tube which lies against the posterior wall of the pharynx. The operator inserts gauze pads to absorb most of the blood in the field of operation and when they are saturated they are replaced. After the operation, when the large pack is removed it should be quite free from blood at the end which was deepest in the pharynx.

The method of anaesthesia which I use is as follows:

1. The patient is admitted to hospital during the evening before the operation. The bowels are emptied and a sedative given to ensure a good night's sleep—usually 1½ to 3 grains of NEMBUTAL. The patient is examined medically and reassured.

2. The following morning up to 3 hours before the anaesthetic the patient is allowed to drink a cup of tea with sugar but very little milk, or a fruit drink or water; thus it is ensured that his stomach, bowels, and bladder are empty when he enters the theatre.

3. One hour before the anaesthetic the patient receives an intramuscular injection of morphine gr. 1/6 with atropine gr. 1/150. Morphine raises the pain threshold and sedates the patient while atropine inhibits the salivary and bronchial glands which otherwise would pour out troublesome secretions.

4. Anaesthesia is induced in the theatre by an intravenous injection of sodium thiopentone. Usually 1 gram is injected slowly and then a well lubricated size 7 Magill tube is inserted into the nose; the cords are exposed with a Mackintosh laryngoscope and the tip of the tube guided into the trachea with a pair of Magill's forceps. The process of intubation usually takes about 2 minutes from the time of commencing the injection of thiopentone. Should the thiopentone be insufficient to relax the cords, an atomiser containing 2% DECICAIN is kept in readiness to spray the larynx: within half a minute the DECICAIN reduces the sensitivity of the cords sufficiently to allow the tube to be passed. Latterly I have used intravenous FLAXEDIL as an alternative to DECICAIN: FLAXEDIL (or gallamine triethiodide) is a general muscle relaxant.

5. A closed circuit anaesthetic apparatus is now connected; the tube is strapped to the face with adhesive plaster, and the patient's lungs inflated with oxygen. Then ether is turned

on so that, as the effect of the thiopentone wears off, so ether with oxygen takes over the maintenance of anaesthesia.

6. The pharynx is packed and the head draped; no mouth prop or gag is needed as relaxation of the muscles of the mandible is good. Since the anaesthetic apparatus is remote from the mouth, operating conditions for the surgeon are will nigh perfect.

7. The patient is maintained in a very light plane of anaesthesia throughout the procedure but 15 minutes before the end of the operation the ether is turned off, thus relying on the ether already absorbed into the patient's tissues.

8. When the surgeon has finished, the pharyngeal pack is removed, the patient turned on to his side and the pharynx sucked out to remove any mucus and blood. By this stage the patient will usually have gagged so the Magill tube is withdrawn and an oropharyngeal airway inserted; often the patient will attempt to spit this out at once. When the patient has recovered all his protective reflexes, he is returned to the ward under the care of a trained sister.

There is now a great demand for intratracheal anaesthesia in dental surgery. In most country towns there is no specialist anaesthetist, and yet the dental surgeon needs and expects the advantages of such a safe anaesthesia. This has created a great problem, the solution to which problem may be for at least one young and enthusiastic doctor in each town to study anaesthesia as a side-line specialty. In England, with its State Medical Service, this problem no longer exists; in fact, general practitioners rarely administer anaesthetics. However, in Australia even if medical practice were completely nationalised, the general practitioners would still have to administer most of the anaesthetics in country towns, because they are so distant from the facilities of the large cities.

The anaesthetic technique which I have just outlined is not the only one possible; another, inferior but almost as good, dispenses with the closed circuit apparatus which involves carbon dioxide absorption and accurate flow meters for measuring gas flows. A much cheaper apparatus can be used incorporating an Ayre's T-piece. The trachea is intubated and the pharynx packed off as before, but anaesthesia is maintained by blowing ether-laden oxygen or air down the tube into the lungs through one arm of the T-piece whilst the expired air passes into the atmosphere through the other arm of the T-piece.

The Present Status of Self-Hardening Resins in Conservative Dentistry*

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Les résines ont de grandes qualités incontestables mais il faut savoir les utiliser à bon escient.[1]

Introduction.

The advantages of self-hardening resins are so well known that they scarcely need receive more than a brief mention. When freshly inserted the acrylic restoration can scarcely be bettered aesthetically; its effect on the pulp is now accepted as minimal by most workers; its expectation of life in the mouth is, as a material, far better than that of silicate cements, but as for its life as a filling judgment must be reserved for the time being.

When first introduced in the present commercial form, self-hardening restorative resins were hailed by the profession, with a few misgivings, admittedly, about their effect on the pulp. Such was their popularity that an American survey[2] in 1951 showed that 18 per cent. of the dentists there had abandoned silicate cements entirely in favour of acrylic resins for anterior restorations, and only 14 per cent. were not using self-hardening acrylic resins at all. Rumours spread that some manufacturers were discontinuing the distribution of their silicate cements to concentrate on restorative acrylic resins, and it appeared certain that the future of the resins was assured.

The pendulum is now swinging the other way, judging by some reports brought back from overseas, and it is the purpose of this paper to analyse the possible reasons for this so that the profession here may be forewarned. In view of the fact that the merits of acrylic resins are either obvious or else well advertised in other ways, most of the paper will be devoted to discussing the adverse criticisms in an attempt to assess whether they are justified or not. As a starting point, a reasonably comprehensive clinical survey of the behaviour of the resins in the mouth was sought, for a little of this can be worth more than much conjecture.

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SURVEY.

Sherman and others: There has been insufficient time for really extensive surveys, but the most detailed published is that of Sherman, Fiasconaro and Cain[3] reported in January, 1952. Unfortunately, only one product was used in sufficient cases for a proper evaluation, and this amounted to 83 cases. The material was mixed and inserted under rubber dam conditions and with faculty supervision, and was examined by three investigators after at least one year's and up to two years' service. The restorations were examined for marginal accuracy, colour, hardness, porosity, contour, finish, abrasion, and sensitivity. Briefly, the findings of these investigators rated hardness, porosity, contour, finish, abrasion, and sensitivity as good; that is less than 20 per cent. unsatisfactory. Marginal accuracy at 42 per cent. unsatisfactory was rated as only fair, while colour retention at 74 per cent. unsatisfactory was poor.

As poor marginal accuracy and colour were the chief offenders, the authors attempted to correlate them with various factors concerning the patient and his habits. The greatest discoloration occurred during the first twelve months, and it was greater on proximal anterior preparations than on posterior and gingival locations. The discoloration appeared to be less with poor oral hygiene, with smokers and where the saliva was thick and ropy. Mouth breathing, consumption of alcoholic beverages or medicaments were not found to affect colour retention. Some of these conclusions have been confirmed with dentists here, particularly the point about less discoloration in gingival and other areas shielded from light.

In regard to marginal accuracy, this deteriorated as time progressed and was about the same for Class III and Class V restorations. The margins appeared to deteriorate more with poor oral hygiene and mouth breathing, but were not found to be affected by tobacco smoking, consumption of alcoholic beverages and medicaments or the nature of the saliva.

These conclusions are very interesting as far as they go, but the number of cases is few from the statistical point of view, and worse still is the fact that the findings were based on one product. The authors clearly recognised these shortcomings and have planned more comprehensive surveys.

Gardner: Another and more extensive survey was briefly reported by Gardner[4] in December, 1952, when reference was made to a three-year clinical study of 2,000 restorations. Unfortunately, the report in the journal contained no details, but its author has kindly given these conclusions regarding marginal adaption:

(1) All acrylic resins tested gave the same results.

(2) Unless there was good preparation with sufficient undercuts, especially using wheel burs for this purpose, there would be failure.

(3) Correct procedure gave complete success over three years in regard to loosening of the filling, but marginal staining did occur with many of them.

(4) There was a definite correlation between dietary habits, caries susceptibility, and age in regard to the lasting properties.

Kraus and Kraus: These workers[5] studied over 500 cases since the beginning of 1947. Although here again there are few details, their findings are summarised as follows:

The self-curing resin restoration does not protect the teeth adequately because—

(1) It does not hermetically seal by compression.

(2) It does not hermetically seal by virtue of cementation.

(3) The chemical (curing) shrinkage cannot be compensated for by expansion due to water absorption.

(4) It percolates mouth fluids through the margins due to its difference of thermal dimensional change.

(5) It is not bacterio- or cario-static in the presence of mouth fluids.

(6) Technique cannot overcome its shortcomings.

(7) The present resins are basically identical.

(8) All exhibited a peculiar softening of the cavo-surface.

Other surveys: There are, of course, many other reports on acrylic resins, but few show themselves to be definite clinical surveys.

Most of them give general conclusions drawn from clinical experience like the recent one of Leatherman[6], who refers to the yellowing with benzoyl peroxide catalyst on exposure to light, but says very little about marginal adaptation. Reports like the excellent one of McLean and Kramer[7], while first-class studies

of the properties of the resins, do not claim to be clinical surveys. McLean and Kramer did point out that discoloration is one of the main causes of objection to the amine-peroxide accelerated materials, but they carried out all their cavity sealing tests at a constant temperature, which condition does not apply in practice. Coy and others[8] studied 600 restorations with two materials over one year. All showed a slight tendency to yellowing, and flow was found in stress-bearing areas.

Finally, reference may be made to the opinions of several workers expressed in a Swiss journal of February, 1953. Stocklin[9] concluded that with few exceptions the discoloration disqualified self-hardening acrylic resin as a replacement for silicate cement. He considered that apart from temporary restorations in crown and bridgework, its use should be limited to a minimum. Castagnola[10], while hopeful for further improvements, felt that all the disadvantages that make the use of self-hardening resins problematic have not been eliminated yet. On the grounds of pulp irritation, Maeglin[11] recommended that the present self-hardening resins be used only for small cavities far from the pulp and with an adequate cavity lining.

Australia: Australian dentists with whom the clinical behaviour of acrylic resins has been discussed have pointed out the two main faults already mentioned. They were almost unanimous on the lack of colour stability of some products. There is far less agreement on the second disability, the development of softness of the cavity floor and an associated peculiar odour and sometimes taste, presumably due to leakage at the margins.

These two faults — discoloration and marginal leakage — correspond to the two faults found by Sherman and others[3] in their survey and attention will be confined to them. If these faults are stressed rather than the well-known merits, it is because first, they should be uppermost in one's mind in deciding whether, where, and when to use acrylic restorations; second, they should put one on guard to watch carefully in clinical practice for evidence of these weaknesses. This will add to the accumulated data which will serve as a guide on future occasions not only to the observant dentist but to his confreres as well.

Discoloration.

First, the question of discoloration will be briefly considered. In 1950, when there was only one type of self-hardening resin on the market, that is the resin using benzoyl peroxide as a catalyst and an amine as a promoter, reports of lack of colour retention were coming through. There was no agreement, however. Some dentists claimed they had experienced no trouble at all, and others complained of the development of a "canary yellow" or a "traffic light orange." Enquiries from overseas were made but few at that time admitted any difficulty. Some admitted a slight yellowing but were inclined to dismiss it as a minor factor and of academic interest only.

Was it because American products were superior to those available here, and if so, why? Little satisfaction was obtained on this point. The manufacturers attributed the trouble to technique, and this indeed was partly the truth. In efforts at the Bureau of Dental Standards to find a laboratory test that would reproduce the yellowing, the nearest was given by nitric acid. It was well known, for example, that nitrated compounds like celluloid rapidly gave an intense orange coloration. Manufacturers did not hold with this view and pointed out that benzoyl peroxide and tertiary amines will react to give bright colours. If through improper technique the polymerisation of the resin is delayed there will be opportunity for these agents to react, but once the restoration has hardened the system is "frozen" and further action prevented unless the resin is subsequently softened.

It was claimed that light was a factor, and particularly ultra-violet radiation. This has been doubted by some who point out that very little ultra-violet radiation can reach the teeth. The fact remains, however, that, as several Australian dentists have pointed out and Sherman's survey has shown, there is greater discoloration on the labial than on the lingual aspects of restorations. This is not necessarily due to light, but may be due to a greater amount of debris on one side, and furthermore, it does not seem to be consistent with Sherman's finding that colour retention is no worse in mouth breathers. There is little doubt that light is an important factor, and it may explain why yellowing was apparently more rapid in Australia than in Canada and the U.S.A. An interesting observation from Switzerland in this connection is that discoloration is more severe at higher altitudes where, of course, ultra-violet light is more intense.

One manufacturer marketed a modifier which speeded up the polymerisation and gave a partly cross-linked, and therefore more chemically stable, resin. On the manufacturer's theory, this would reduce the opportunity for benzoyl peroxide and amines to react, and hence lessen the discoloration. It

did in fact do this both in laboratory and clinical tests, but discoloration was still not totally prevented. (A later and more radical modification is now marketed by this firm, but it is too recent an innovation to comment upon.)

A more promising approach is given by those resins based on an entirely different catalyst, toluene sulphinic acid[7]. Laboratory tests confirm clinical reports that there is practically no change of shade in these resins, at least up to two years' service. As there are no benzoyl peroxide and amines in this type of resin there is no inherent tendency to discoloration on that account.

Thus, one difficulty appears to have been overcome, but the waning popularity of self-hardening restorative resins in America and Europe has still to be explained. There are several factors to be considered. For example, the dentists on the American continent are now finding that the colour constancy is not as good as at first believed, and toluene sulphinic acid resins may have arrived too late to save the day. On the other hand, there may be some other different or additional reasons.

Marginal Leakage.

The problem: A few dentists in Australia have pointed out that on occasions when acrylic restorations have been removed they have noticed a softening of the cavo-surfaces and a peculiar odour. Sometimes the patients have mentioned a taste while the restoration is still in place, and the odour can be noticed on a piece of floss silk drawn across the margins. The literature was searched for confirmation of this behaviour in overseas experience, and contact was also made with various authorities and manufacturers.

Before dealing with possible explanations, here is a summary of the statements on the phenomenon itself. Kraus and Kraus[5] in their 1951 report of a study of over 500 cases, said that all exhibited a peculiar softening of the cavo-surfaces.

Rosen[12] has been reported as writing:

> If the plastic restorations are compared clinically with those of amalgam, gold, or silicate cements, at the end of one year's service in the oral cavity, it will be found that the plastic restoration will be the easiest removed, and what is more distressing, the exposed tooth structure will be soft and smelly.

Some authorities[13] found such failures were chiefly confined to Class V cavities, and the trouble is found fairly shortly after insertion. The patient complains of a foul taste and the dentist finds a loose filling. Another considered this as the most serious aspect of self-hardening resins. Odour and cavity softness, he said, is a relatively common experience, but he claimed that most trouble arises from restorations subject to stress, although he admitted there is also a definite percentage in protected areas. Others have written to say that they have noted such behaviour, and put it down to marginal adaptation.

It appears therefore that there is a growing awareness of the second great disability referred to in Sherman's survey[3], and it remains to be seen what is the probable cause of marginal leakage and cavity softening and how it can be overcome.

The cause: When the properties of acrylic resin are compared with those of silicate cement and amalgam which do not exhibit this fault to anything like the same extent, there are several striking differences which are considered relevant.

(1) Dimensional change on setting of cements and amalgams are minimal, acrylic curing shrinkage is large.

(2) The elastic modulus of acrylic resin is much lower than that of the other filling materials; that is, it will deform farther under a given stress.

(3) Thermal expansion of acrylic resin is from five to ten times that of the other restorative materials.

(4) Acrylic resin is practically inert bacteriologically, whereas it has been shown that, in service, silicate cements and amalgams or their breakdown products exert significant bacteriostatic effects.

It is to some or all of these factors that one should look for the difference in behaviour between the self-hardening resin and the other restorative materials. Each will be considered in turn.

Curing shrinkage: The significance of this well-known failing has been discussed many times before, and one has seen the development of special pressure matrices, and brush technique, the drop technique, the stratified layer technique, and the use of cavity adhesive — all designed to minimise the ill effects of the shrinkage which must take place somehow. All achieve their purpose, at least to some degree, at the time of placement, and McLean and Kramer[7] support this.

Fiasconaro and Sherman[14] placed standardised restorations in freshly extracted teeth in such a way that air pressure could be applied from the pulpal chamber to the base of the restoration. With the tooth placed in water, the air pressure was increased until an air bubble appeared at the cavo-surface

margin. It required over 50 lb./sq. in. for gold foil, zinc phosphate cement, and some amalgams, 45 for a cemented gold inlay, 38 for silicate cements, and less than 10 for all techniques for self-hardening resin. The brush technique fillings resisted about 7 to 8 lb./sq. in. against an average of about 6 for the pressure technique, so it would appear from these tests that the improvement in marginal seal is not very great; in fact, it is negligible when compared with the seal obtained with other restorations and inlays. The authors admit that they do not know the real significance of these tests, for it is not known what pressure a seal should resist. It may be that 5 or even 1 lb./sq. in. corresponds to a satisfactory seal clinically, but this is doubtful when other factors are taken into consideration.

In discussing marginal adaptation not only must the seal given when the filling is placed be considered, but also what obtains after the filling has been in service, but whatever changes may take place later it is obvious the marginal seal of acrylic restorations is destined to be a weakness right from the start. It is considered that this applies to all types of conservative resin so far developed.

Elastic Modulus: Acrylic resins have a relatively low modulus of elasticity compared with silicate cement or amalgam, but at the same time they will recover after quite large deformations, a property which cements and amalgams lack. The latter materials will break or crumble rather than deform, but they need relatively large stresses to do this. On the other hand, acrylic resin has a marked flexibility or "springiness." This may be an advantage in some instances but is a great disadvantage in restorations for several reasons. One will be mentioned here.

Near the surface margins of cavities there are enamel rods with little underlying support. The restoration should provide a firm base to react to any oblique stress which would otherwise find the enamel rods in their weakest position and break them away. On account of its flexibility, acrylic resin is deficient in this regard. The danger becomes greater, of course, with the box-like cavity without the bevelled edges that are contra-indicated for acrylic restorations.

This lack of support which would apply to all types of resin and all techniques may be responsible for the crumbling of margins and consequent staining which is sometimes seen, but cannot wholly explain the leakage which appears to occur around the whole restoration. It may also explain the failures sometimes reported with occlusal and other stressed fillings.

Thermal expansion: This property is receiving much publicity of late chiefly as a consequence of the report of Nelson, Wolcott and Paffenbarger[15] on fluid exchange at the margins of dental restorations. These striking experiments can readily be repeated by anyone. Restorations are prepared in extracted teeth, or are extracted after filling. If the filled teeth are immersed in ice-cold water, wiped dry, and then warmed by holding in the fingers, droplets of water will appear at the margins and may be readily observed under low-power magnification.

Presumably this is due to the difference in the thermal contraction between the acrylic resin and the tooth structure, the latter being about one-tenth of the former. Cooling contracts the restoration, opens up the margins and fluid enters. Warming reverses the process and the fluid is forced out.

Percolation occurred irrespective of the type of cavity, the type of resin or the technique used, and also occurred with freshly inserted silicate cement, amalgam, gold foil, and cast gold. The authors used the thermal expansion hypothesis to explain the percolation obtained with acrylic resin, but this did not apply to the other materials which have co-efficients of thermal expansion fairly close to that of the tooth structure. The latter effect was thought to be due to the thermal expansion of the fluids in minute defects between tooth and restoration. This is one of the weaknesses in the paper, for if this is an adequate explanation for amalgam, one would imagine it should suffice for acrylic resin. There are other doubtful points; for example, it has been found here that in marginal percolation the water appears for only a short period, then disappears back into the margins. Furthermore, heating the restoration direct, instead of the tooth, as is the case with holding in the fingers, does not appear to intensify the phenomenon, and this is contrary to expectations.

Using thermocouples placed on the floor of an actual cavity and covered with acrylic resin, Nelsen and others[15] found that by drinking iced water to very hot coffee a range of 9°C. (48°F.) to 52°C. (126°F.) was obtained. In a meal with hot and cold fluids and foods one can imagine the acrylic resin expanding and contracting accordingly, and so pumping fluids in and out of the margins. The contraction of the margins would theoretically be sufficient to allow the ingress of bacteria, and certainly of proteolysing or decalcifying enzymes. However the figures quoted for the extreme temperature range have been challenged. With most people, it is claimed, there is an involuntary act of cheek, lip, and tongue protection of teeth from

thermal shock. Others claim that trouble occurs mainly with gingival fillings in lower teeth, whereas thermal changes would be most effective in upper incisors and large fillings.

The effect of thermal changes on marginal seal was well demonstrated by Fiasconaro and Sherman in the laboratory test previously described[14], but here again its real significance is not known. It does confirm, however, that acrylic resin fillings will expand and contract markedly with thermal changes. It must be conceded that thermal expension, or more particularly contraction, is a definite contributing factor in the leakage of acrylic restorations, but it is felt that it does not constitute the whole story.

Germicidal properties: Past studies have demonstrated that silicate cements and amalgams have bacteriostatic and cariostatic effects and, judging by their initial marginal leakage as demonstrated by Nelsen and others[15], this is a good thing. Whether it is the fluoride in the silicate cements and the corrosion products of amalgams that give these properties or not, there are no such properties in acrylic resins. Even if some of the substances used in acrylic resin were bacteriostatic, it would be very difficult for them to leach out, and so it is unlikely they would be effective.

As Kraus and Kraus[5] in their bacteriological study of acrylic restorations found oral bacteria in all cases and areas, it is obvious that germicidal properties would be of great advantage.

What Should Be Done?

It now remains to see what can be done to minimise the poor adaptation of acrylic margins. The four properties referred to will be discussed in this light and some general precautions added.

Crung shrinkage: To minimise this, follow the manufacturers' directions carefully. In the pressure inserted restorations be sure that adequate pressure is maintained for the necessary time, and be careful of the margins, particularly the gingival ones. Better results are to be expected with the laminated layer and the brush techniques, and the use of these methods should be encouraged if applicable to the product of choice.

Next, there is the use of cavity adhesives or adhesive resins (or the "reactor technique" where extra activator is painted round the cavity to speed up polymerisation on the surfaces first). The idea of adhesiveness is to hold the resin at the cavo-surfaces and so force the shrinkage to take place from the free surface of the restoration.

Experiments with these adhesives on glass and tooth surfaces show increased adhesion, particularly when the film of acrylic resin is thin, but this adhesion is soon lost when the specimens are subject to mild heating and cooling cycles. If the adhesiveness is stated to be of use on placement of the restoration, there may be some justification, but any claims for continued adhesiveness in service should be discounted. As Lucas[16] has said:

> Any suggestions that direct plastics are firmly adherent to the cavity walls are naive in the extreme in the face of such excessive changes of volume.

Tests with marginal seepage showed no detectable difference between the various products when used with or without cavity seals or modifiers to increase adhesiveness.

Elastic modulus: Nothing much can be done about this by the dentist except to recognise it as a weakness and avoid restorations where the high flexibility of the material would be detrimental, particularly in any stress bearing position. Acrylic jacket crowns should have a metal or ceramic core, for example. If it is doubted whether this property is important, it is instructive to press acrylic restorations in extracted teeth that have been soaked in water, preferably iced water. Even thumb pressure will sometimes cause the water to well up at the margins. This does not happen with the other restorative materials.

It is possible that manufacturers may endeavour to increase the elastic modulus by the use of cross-linking interpolymers or by the addition of fillers.

Thermal expansion: Very little can be done about this property either. The effect on margins will be greater with larger restorations and acrylic crowns would be particularly susceptible. It is possible that manufacturers may be tempted to load the acrylic resin with mineral fillers or other materials with a low thermal expansion.

Germicidal properties: There are two possible developments. A germicidal lining could be used; for example, Kraus and Kraus[5] think self-hardening restorations would be satisfactory in this regard if removed and cemented in with zinc phosphate or silicate cement. If a zinc phosphate cement lining is used before placement of the filling it should suffice. It may be thought that use of zinc phosphate cement is a retrograde step, but the results of a very extensive clinical survey by Grossman[17] have demonstrated that pulp deaths are almost eliminated when such a lining is used.

A second approach, the incorporation of a bacteriostatic agent in the restoration, is not very hopeful as the agent would be practically immobilised in the cured resin.

General: There are one or two other factors which are important in relation to cavity seals. As pointed out by several workers,[6, 18] the maintenance of a dry field is essential. Moisture interferes with the initial polymerisation and a soft edge may be obtained. According to McLean and Kramer[7] this is particularly important with the sulphinic acid accelerators which are water soluble. If the edges of such fillings are subjected to marginal seepage during polymerisation, the material will tend to disintegrate, so producing faulty edges. To ensure driest conditions the appropriate use of rubber dam is strongly recommended.

Every care should be taken with the preparation of the cavity to give adequate retention, and especial care should be taken of the margins, remembering that acrylic resin is too flexible to be a first class support for enamel rods, but at the same time bevelled edges cannot be tolerated on account of the tendency of the acrylic flange to lift.

Finally, the type of restoration should be appropriate for acrylic resin. While very large restorations are subject to the greatest thermal dimensional changes, very small restorations may not generate sufficient heat for adequate curing. Lucas[16] has made a list of where and when acrylic resins should not be used. These are contra-indicated:

(1) Patients with high caries susceptibility.

(2) Patients with incorrigibly poor hygiene.

(3) Pre-adolescent children.

(4) Posterior compound cavities.

(5) Inaccessible situations.

(6) Jacket crowns (except as temporary or makeshift expedients).

(7) When adequate chair time is not available.

Conclusions.

It is obvious that the subject is rather confusing at present, and until more is known about recent and future developments it is recommended that the resins should still be used with discretion and, above all, that the results are closely observed even if it means removing and replacing an occasional restoration.

The following precautions in the use of self-hardening resins should be noted:

(1) Avoid all types of cavity where the use of acrylic resin is definitely contra-indicated by theory or experience.

(2) Choose the most recently developed products known to have good colour retention.

(3) Follow the manufacturer's directions carefully.

(4) Maintain a dry field, using rubber dam if necessary.

(5) Use a suitable cavity lining.

After this somewhat gloomy picture it is refreshing to read the conclusions of Leatherman[6] who, while admitting the material must be handled with skill, knowledge, and intelligence, has recently said,

> . . . the material will undoubtedly be abused and probably condemned, but in my opinion it is here to stay and, with further research improvements, will be the accepted and universal material of the future.

We trust his optimism will prove to be justified.

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Editorial

This journal is published by the Australian Dental Association (New South Wales Branch), B.M.A. House, 135 Macquarie Street, Sydney. Communications concerning literary matter should be addressed to the Editor and all advertising and business matters directed to the Secretary.

Subscription rate is £1/5/- per annum (Aust.); £1/10/- per annum outside Australia. Single copies, 5/-.

Original communications: Manuscripts should be typewritten on one side of the paper only, with double spacing and liberal margins. Carbon copies should not be sent. References should be placed at the end of the article and should include, in the order given, name of author, title, journal, volume, initial page of article, month and year; e.g., Wallace, J. S.—The newer knowledge of hygiene in diet: Dent. Items Int., 69:38 (Jan.) 1947. References to books should include the following information: name of author, title, edition, place of publication, name of publishers, year and page (if necessary).

Illustrations: These should be kept to a minimum. Suitable captions with number and author's name should be marked on the back of all illustrations. Photographic prints should be approximately 5 in. x 4 in. and printed on glossy paper. Authors unaccustomed to preparing drawings and photographic prints for reproduction are invited to seek the advice of the Editor.

The Royal Tour

By the time this Journal is in the hands of the readers, doubtless, the visit of Her Majesty, Queen Elizabeth II, and His Royal Highness, The Duke of Edinburgh, will be only a happy memory. However, at the time of preparing this issue, our Queen is in our midst and Australia is paying homage to her in a spontaneous and overwhelming fashion.

It has not been the time for formal presentations of loyal addresses by particular bodies, but rather a greeting by individuals and families to their beloved Queen. Throughout her tours, she has been met by huge groups, all demonstrating their undoubted loyalty and affection which the members of the Australian public have for her.

In a quieter moment we might wonder what attributes there are in addition to the obvious glamour of her position and her own personal charm which have made this visit so outstanding. Through her every action there is a sense of simple dignity coupled with evident sincerity which, in one so young, burdened with such responsibility, awakens a flood of affectionate emotions in all who see her.

Australia undoubtedly has been greatly honoured and more firmly bound into the British Commonwealth by Her Majesty's visit.

It is pleasing to note that the dental profession has been favoured by invitations to its senior Federal and State officers to attend various official functions during the Royal Visit. The opportunity afforded of expressing in this manner the allegiance of the dental profession in this country to the throne was sincerely appreciated.

Visit of Professor Bibby

During the latter months of 1953 Professor Basil Bibby, of the Eastman Dental Dispensary, Rochester, U.S.A., came to Australia at the invitation of the Australian Dental Association, and under the auspices of the United States Educational Foundation in Australia. He visited the three eastern States and, in addition to giving numerous lectures, he had discussions with heads of health services, Ministers for Health in different Governments, and leaders of the medical and dental professions.

There is no doubt that Dr. Bibby acted as a prophet from another country and during his visit some seeds of activity may have been sown in political spheres and amongst leaders of public health instrumentalities — bodies which, whilst retaining control of all dental services, have remained both ignorant of and apathetic to the problems concerned with this particular aspect of public health for such a long time.

As our knowledge has increased, our problems have changed from seeking ways of restoring the ravages of dental caries to searching for methods by which the disease itself might be combatted. In this regard Professor Bibby pointed out the spectacular success of the fluoridation of public water supplies in reducing the incidence of dental caries, particularly amongst children, and we trust he slew some of the mythical monsters which so regularly raise their heads at the merest mention of fluoridation and which have apparently succeeded so well in completely frightening so many members of these bodies which have no adequate dental representation within their organisations.

Perhaps one of the most refreshing aspects of Professor Bibby's lectures was the fact that it was apparent that gradually the huge problem of the effect of diet on dental caries was being resolved. The prevention of dental disease has undoubtedly been the most difficult thing for dentists to effect through the co-operation of their patients. This certainly has been due to the fact that in the past the profession could do little more than recommend that their patients go without all the things that the majority of them liked to eat. Now, however, Professor Bibby has pointed out that, thanks to basic research, we are reaching a stage where a far more realistic and moderate approach to this problem can be adopted. In such an approach we may seek to bring about variations in eating habits and a

selective restriction of carbohydrates. Through such means it should be possible to obtain far greater co-operation from one's patients and it is also possible that more rapid and spectacular results might be expected.

Dental Materials

*Current Notes (No. 24)**

SILVER SOLDERS.

In joining austenitic stainless steel components three courses are open—mechanical jointing, welding, or soldering. Much ingenuity has been displayed in all of these techniques, particularly in the preparation of orthodontic appliances. For this purpose two requirements besides the strength of the union must be met—the physical properties of the components joined must not be adversely affected by the process, and the joint must remain relatively inert to oral fluids.

The range of solders that can be successfully applied to stainless steel is limited and it is fortunate that silver solders can be used given a suitable flux. Although they appear not to alloy with the components, as the solders used with precious metals do, silver solders closely adhere to the stainless steel. If these solders are used they must be of a composition that will give both suitable fusing properties and resistance to tarnishing and corrosion in the mouth.

There are many silver solders available for industrial purposes. They are essentially alloys of silver, copper, zinc, and cadmium but only a few are suitable for dental use. The first limitation is the exclusion of alloys containing more than a very small amount of cadmium since this element lowers the chemical resistance. Copper and zinc must be kept below a total of 40 or 50 per cent. for the same reason.

An examination of available silver solders used in dentistry has indicated that a suitable composition range is silver 50-65 per cent., copper 20-35 per cent., and zinc 10-15 per cent. The few industrial solders of satisfactory fusing properties meeting these requirements include those corresponding to Grade A of B.S. Specification 206 and Grades 5 and 6 of A.S.T.M. Specification B73.

In its dental materials programme the Standards Association of Australia is now considering various orthodontic materials and silver solder has been suggested as one item requiring standardisation. Opinions as to the most satisfactory silver solder found in practice would be appreciated for guidance in the preparation of draft specifications.

*Contribution from the Commonwealth Bureau of Dental Standards; suggested by Dr. J. Wunderly.

Change in Numbers

Subscribers are advised that henceforth the Dental Journal of Australia will be produced every second month. Copies will be numbered from one to six respectively, and dated the second and every alternate month.

News and Notes

Fluoridation of Drinking Waters—National Health and Medical Research Council

A brief resume is set out below of the consideration given by the National Health and Medical Research Council of Australia to the matter of fluoridation of drinking waters for the partial control of dental caries. Attention is specifically drawn to the resolutions of the Council which are set out in full.

The importance of these policy decisions lies in the fact that the National Health and Medical Research Council is the most authoritative advisory body on health problems in the Commonwealth.

Before any State or public health authority would endorse the establishment of fluoridation of public water supplies such a responsible body would naturally require the fullest official scientific support. Therefore, the Australian Dental Association has strongly pursued this plan for endorsement which we are now pleased to see released for general information.

The matter of fluoridation of drinking waters for the partial control of dental caries was brought before the National Health and Medical Research Council by this Association's representative in 1949-50.

The Council gave consideration to the various memoranda presented on those occasions and considered the matter of moneys for a survey in connection with the procedure. This projected survey, however, was abandoned in November, 1951.

Steps were immediately taken by the Association, through its representative, to present a further extensive memorandum in order to keep the matter before the Council.

The Council at is 33rd Session in May, 1952, formulated certain resolutions and the published Minutes of this meeting read:—

FLUORINE IN WATER SUPPLIES: ACCEPTANCE OF AMERICAN DATA.

The Council, whilst considering the applications for grants, had a lengthy discussion on the subject of fluoridation generally and, upon further consideration, decided to accept the American data concerning the effect of fluoridation of water supplies upon the incidence of dental caries.

A resolution on the subject was passed by the Council (Resolution 2).

RESOLUTION 2.—FLUORIDATION OF DOMESTIC WATER SUPPLIES.

The Council, in view of the practice advocated by responsible American medical and dental authorities in respect of fluoridation of water as a factor in the control of dental caries, considers that the addition of fluoride to water supplies to be a reasonable and safe measure, provided the addition of this substance is carried out under strict supervision and scientific control to ensure that the percentage does not exceed accepted standards laid down by the State Health Departments.

The use of this substance as a means of self medication is strongly condemned.

During the 34th Session of the Council in November, 1952, the question of a survey on the prevalence of dental caries was discussed and deferred for consideration at the next meeting.

At the 35th Session of the Council in May, 1953, a report of the Public Health Committee of the Council raised certain pertinent points concerning fluoridation of concern to public health authorities which arose from the Council's resolutions passed at the 33rd Session.

The matter was referred to the newly reconstituted Dental Advisory Committee and a report was prepared by this Committee and submitted to the 36th Session of the Council in December, 1953. At this meeting the following two resolutions were passed:—

RESOLUTION 1: (Conditional upon Resolution 2).

(i) This Council is of the opinion that an optimal intake of Fluorine is a factor in the prevention of dental caries.

It must be admitted, however, that an adequate supply of Fluorine in drinking water will not of itself provide the solution of the problem of dental caries. There are other factors, particularly dietary, involved in the control of dental caries.

(ii) Having considered published reports of the claims for and against artificial fluoridation of public water supplies, this Council recommends that, when the optimal intake is not obtained from natural sources, Fluorine be added to the Public water supply.

(iii) The habitual use, from early infancy onwards, in a temperate climate, of water containing 1 p.p.m. fluoride has been shown to confer the greatest degree of freedom from dental caries which can be secured by this means without risk of disturbance to any bodily structure or function.

For such children, the average daily intake of fluoride from all sources, when the water contains 1 p.p.m. fluoride, has been determined for various age groups from 1 to 12 years. According to age, this intake ranges from 0.4 to 1.7 mg.

For adults, an average daily intake of water ranging from 1200 to 1500 ml. would result in an intake of 1.2 to 1.4 mg. fluoride. In addition there will be a computed daily intake of 0.2 to 0.3 mg. fluoide from food, the total daily intake of fluoride will, therefore, be 1.4 to 1.8 mg.

On the basis of observations made on a population whose daily fluoride intake is within the range stated, and of observations on the excretion of fluoride, there is no evidence that fluoride will accumulate in the body to an undesirable extent when the daily intake is less than 3 mg. fluoride.

(iv) There is no conclusive evidence that any deleterious systemic effects will follow the habitual use of water containing 1 p.p.m. of Fluorine.

(v) Although this Council can see no reason why the dental benfits of fluoridation of water should, at this stage, be denied to the Australian people, it is emphasised that concurrent research is essential in order to assess the results of treatment of the water and to determine accurately the optimal concentration of Fluorine under Australian conditions.

(vi) Any plan to fluoridate the domestic water supply must be subject to the following conditions:—

(a) The need for increasing the concentration of Fluorine in the water supply must be established.

(b) A large proportion of the community should desire that Fluorine be added to the water supply, or alternatively, a substantial proportion of the community does not oppose the addition of Fluorine to the water.

(c) The water supply must be amendable and subject to strict supervision and control by qualified engineers and chemists.

(d) The amount of Fluorine to be added must be carefully determined and adjusted to meet climatic and environmental changes.

(vii) A properly controlled national study of water fluoridation under Australian conditions should be instituted immediately:

(a) To determine the results of water treatment.

(b) To determine more accurately the optimal concentration of Fluorine.

(c) To permit of valid comparisons between the observations made in different parts of Australia.

(viii) This study should embrace:

(a) Survey of oral conditions in representative samples of children and adolescents.

(b) Influence of climate upon water consumption.

(c) Excretion of Fluorine in the urine of sample groups of children and adults.

(ix) In order to obtain comparable results, the Council recommends the establishment (at the Institute of Dental Research, under the supervision of Dr. N. E. Goldsworthy) of a course of instruction in standardised procedures and practice for oral examinations.

In order to co-ordinate (b) and (c) of (viii) the Council recommends the appointment of an advisory panel consisting of Professor Macfarlane, Dr. Hipsley, Dr. N. Crosby and Dr. Goldsworthy.

(x) The Council considered the question of self-medication with fluoride, and strongly deprecates the inexpert and indiscriminate self-medication with fluoride for the purpose of partial control of dental caries.

RESOLUTION 2:

This Council recommends that each State set up an Advisory Panel within its Health Department to review, advise on and supervise proposals for the addition of Fluorine to communal water supplies. These panels should include representatives of the medical and dental professions and public health, a water engineer and a chemist.

University of Sydney Post-Graduate Committee in Dental Science

There are still some vacancies in the following courses of instruction arranged for 1954. As the number of members of each post-graduate class is limited, except the class in Public Health Dentistry, early application is essential.

If any member of the profession is desirous of attending any of the undermentioned courses, he should communicate with the Secretary of the University of Sydney Post-graduate Committee in Dental Science, Dental Hospital of Sydney, Chalmers Street, Sydney.

A. J. ARNOTT,
Chairman.

Course No. 38: *Crown and Bridge Work.*

24th May, 1954, to 28th May, 1954.

Fee for Course—£12/12/0.

Clinicians: Mr. N. W. Kestel, M.D.S. and Mr. K. H. Caisley, B.D.S.

This course will cover both the theoretical and practical aspects of the restoration by fixed bridgework of short-span edentulous spaces and the restoration of the various conditions of fractured anterior teeth.

Course No. 39: *Partial Denture Construction.*

31st May, 1954 to 4th June, 1954.
Enrolment limit—12.
Fee for Course—£15/15/0.
Clinicians: Dr. J. H. Wilson and Mr. K. P. Mackinnon, M.D.S.

The course will consist of illustrated lectures, clinical methods and technological demonstrations, upon the following aspects of the subject: partial denture prosthesis as a preventive health service, the biological, physiological and pathological factors involved, diagnosis, and prognosis for partial dentures, impressions, occlusion, retention, design of plastic and metal dentures in relation to periodontal tissue, technology and the scientific use of various materials used in partial denture construction.

Course No. 40: *Short Course in Orthodontics*:

9th August, 1954 to 13th August, 1954.
Enrolment Limit—15.
Fee for Course—£12/12/0.
Clinicians: Dr. W. N. Benson and Mr. R. Y. Norton, M.D.S.

Lectures and films dealing with the following subjects will be given: (i) normal occlusion, (ii) malocclusion, (iii) methods of case analysis and diagnosis, (iv) aetiology of malocclusion, (v) prevention of malocclusion, (vi) brief review of modern methods of treatment and discussion of problems to meet the increasing demand for orthodontic treatment. Demonstrations and table clinics covering the following subjects will also be given: (i) record taking for case analysis including cephalometric radiograph, (ii) observation of patients for case analysis, (iii) construction of simple space retainers, bite planes, plates for simple movements, etc. The object of the course is to assist the general practitioner to understand the problem of malocclusion in order to render treatment in selected cases.

Course No. 41: *Preventive Dentistry*:

16th August, 1954 to 20th August, 1954.
Enrolment Limit—12.
Fee for Course—£10/10/0.
Clinicians: Mr. N. D. Martin, M.D.S. and Dr. H. R. Sullivan.

All modern caries control techniques will be described and evaluated. Where necessary these techniques will be demonstrated. These will include: (i) Topical application of fluorides, (ii) topical application wth reference to impregnation techniques of Zinc ferrocyanide and silver nitrate, (iii) dentifrices and mouthwashes; ammonium, penicillin, urea and fluoride and chlorophyll, (iv) use of low carohydrate diets with actual diet plans for the treatment of rampant caries in patients of all ages, (v) refined and natural sugars and their effects on caries susceptibility, (vi) tests for caries susceptibility including lactobacillus estimations in saliva for use with low carbohydrate dietary control. Chemical susceptibility tests will also be demonstrated, (vii) the use of water fluoridation for partial control of caries will be studied as a public heath measure. Fluorides as dietary supplements will also be discussed.

Here is an essentially practical application of all the findings of modern dental research and dealing specially with caries control measures which may be utilized in dental practice.

Course No. 42: *Full Denture Construction*:

23rd August, 1954 to 27th August, 1954.
Enrolment Limit—10.
Fee for Course—£15/15/0.
Clinicians: Dr. C. H. Graham and Dr. A. G. Rowell.

This course will cover the clinical and laboratory procedures associated with recent advances in full denture construction. Lectures and clinical demonstrations will provide instruction on dental materials, impression techniques, methods of recording jaw relationships, arrangement of artificial teeth with emphasis on esthetics and phonetics, prosthetic malocclusion and edentulous anomalies with their appropriate treatment.

Course No. 44: *Inlays*:

8th November, 1954 to 12th November, 1954.
Enrolment Limit—12.
Fee for Course—£12/12/0.
Clinicians: Mr. W. A. Grainger, M.D.S. and Dr. E. H. Bastian.

The course will comprise instruction on principles of inlay cavity preparation, advanced design of preparations for special purposes, pinlays, pinledge, three-quarter veneers and full cast crowns. Hydrocolloid and other indirect impression techniques, construction of dies and casts for cases involving multiple restorations, vacuum investing and casting techniques will be included. Instruction will also be given on the handling of waxes, investments and selection of gold alloys.

Course No. 45: *Public Health Dentistry*:

8th November, 1954 to 19th November, 1954.
Fee for Course—£21/0/0.
Lecturers: Dr. H. O. Lancaster, Dr. F. W. Clements, Dr. H. R. Sullivan and Mr. R. Harris, M.D.S.

The course will consist of:—

(a) Statistics:
- Description of a survey.
- Description of a population—such as height, weights, caries incidence, haemoglobin values, tooth measurements, etc.
- Variability (standard deviation and standard error of a mean).
- Tabulation (construction of tables).
- Graphical methods.
- Tests of significance (plus "t" test, etc.).
- Analysis of variance.
- Planning of experiments.
- Punch cards.
- Further statistical techniques: Chi squared and correlation.
- Practical tutorials on above subjects.

(b) Public Health Dentistry:
- Review of existing public health dental services.
- Dental programmes designed for specific purposes and age groups.
- Evaluation of dental programmes.
- Practical dental surveys.
- Child management and study of a child health centre.
- Dental health education projects.
- Problems of pedodontics related to public health measures.

Course No. 46: *Orthodontics*:

Twelve months commencing 4th February, 1955, every Friday morning.
Enrolment limit—8.
Fee for Course—£36/15/0.
Clinicians: Dr. W. N. Benson and Mr. R. Y. Norton, M.D.S.

The course will include (i) series of lectures covering the field of Orthodontics, (ii) instruction in the technique of band formation, and appliance design, (iii) practical case analysis and diagnosis, (iv) treatment of selected cases of malocclusion (v) observation of cases under treatment or cases of special interest that may present.

A.D.A. - B.M.A. Cricket Shield

The annual Doctors vs. Dentists Cricket Match was held at the Sydney Cricket Ground No. 1 on Wednesday, 20th January, 1954.

After a period of years, the shield has passed, by virtue of a well merited victory by three runs, to the Doctors.

Second Country Convention—Orange 20th-24th September, 1954

The Second Country Convention of the Australian Dental Association, New South Wales branch, will be held at Orange from 20th to 24th September, 1954, inclusive.

Following upon the marked success of the First Country Convention held at Armidale in 1951, the Association is confident that members will appreciate the opportunity of attending a further convention.

The duty of appointing a Convention Commission and conducting Convention proceedings has been delegated to the Western Division. Already the Officers of the Convention have enthusiastically taken over the task of organising accommodation for the Convention and for members attending, of setting out a programme of lectures and clinics, and are proceeding to invite outstanding clinicians and lecturers to attend the Convention.

Orange, being centrally situated within the State and with its advantages of climate and tourist attractions, will form a most attractive background to the more serious aspects of the Convention.

A simplified practical programme of lectures, table and silent clinics and films is envisaged, and ample time has been allowed for the enjoyment of sporting and social events.

The Convention Commission looks forward to your attendance on this occasion.

Dental Health Competition Best Children's Teeth in State

During this year a new departure as to dental health competitions will take place. The Association, through its Dental Health Education Department, is pleased to co-operate with the Youth Welfare Association of Australia in arranging a competition to find children with the best teeth in this State.

The Youth Welfare Association is well known to the dental profession for its maintenance of Hopewood House, Bowral, amongst other children's homes and training centres.

This Association has pledged the support of dentists in New South Wales to this project which, given wide publicity, cannot help but to draw the public's attention to the necessity for the maintenance of good dental health.

Valuable prizes will be provided by the Youth Welfare Association and extensive publicity through press, radio and other avenues is planned.

Further details will be forwarded to members of the competition at a later date and also published in this Journal.

Dental Services Reunion and March, Anzac Day, 25th April, 1954

Reunion.

A reunion of all eligible ex-members and serving members of the Dental Services of all arms will be held at the Real Estate Institute's Hall, 30a (basement) Martin Place, Sydney, on Friday, 23rd April, 1954.

Over 70 members attended a similar function last year and voted it an outstanding success. Contact your representative (Mr. J. W. Skinner, M.D.S.) as soon as possible and help the Honorary Committee by letting him know of your intentions, as catering can only be based on firm numbers.

Time: 5.30—9.30 p.m. Refreshments and hot buffet meal.

March.

Present information is that the Anzac Day March will be held on Sunday afternoon, 25th April. Join in with the 70 who marched last year, and make this March even a prouder effort than previous Marches.

Assembly points will be published in the daily press a few days prior to 25th April.

Tufts College Dental School Postgraduate Division

A course in Oral Pediatrics will be held from 12th to 16th July, 1954, and will be conducted by Dr. J. C. Brauer. It will consist of lectures, didactic instruction and clinical work by the participants under the supervision of Dr. Brauer assisted by Dr. F. Shiere of the Oral Pediatrics Department of Tufts Dental School.

A course in Inlay Construction, under the direction of Dr. Donald A. Keyes of the University of Nebraska, will be held from 11th to 15th April, 1954.

Further details of these courses may be obtained from the offices of the Australian Dental Association, 135 Macquarie Street.

Association Activities

Australian Dental Association (New South Wales Branch)

General Meetings.

As is customary, no General Meeting of the Association has been held since the Annual General Meeting on the 17th November, 1953.

The first General Meeting of the Association for 1954 is set down for Tuesday, 23rd March, when Dr. A. W. Bull will be the lecturer. Dr. Bull will talk on a number of developements in dentistry he observed during his appointment as Assistant Professor at the North Western University of Chicago in the United States of America.

The Syllabus Committee has arranged an attractive tentative programme of lectures and clinics for the balance of the General Meetings during 1954.

The General Meeting for the month of April has been advanced to Tuesday, 4th May, in order that members may have the opportunity of hearing Mr. Terence G. Ward, M.B.E., F.D.S., R.C.S. (Eng.), L.R.C.P., L.R.C.S., L.D.S. (Edin.), who is visiting Australia through the courtesy and generosity of the Sydney Myer Charitable Trust and under the aegis of the Dental School of the University of Melbourne.

Mr. Ward's immediate interest is in Oral Pathology and Oral and Maxillo-Facial Surgery. His considerable experience of the National Health Scheme in England and as consultant to the Royal Air Force should add interest to the talk to members on this occasion.

It is hoped that Mr. A. R. Docking of the Commonwealth Bureau of Dental Standards will be available to lecture at the General Meeting on 25th May, and the General Meeting of the 22nd June has been set down as the occasion for the Annie Praed lecture for 1954.

Executive Report.

The usual monthly meetings of the Executive have been resumed following the January recess and the following matters bear report:

Fact-Finding Committee.

The Executive has been able, subsequent to completion of the sittings of this Committee and the submission to the Minister of the Chairman's report, to circularise all members with a precis of the facts and arguments placed before the Committee on behalf of the Profession by this Association. The Executive feels that this precis contains much material which will be of interest to members and useful in their discussions with patients and the public of the various proposals made to amend legislation in relation to dental practice. Any member who has not received this precis is advised that further copies are available.

Dental Health Competition.

The Association has been pleased to co-operate with the Youth Welfare Association of Australia in arrangements for a Dental Health Competition to be held throughout New South Wales. The competition is to find the children with the best teeth in this State.

The Executive is sure that the co-operation of all dental practitioners will be forthcoming for this competition and that they will assist by attending to the preliminary examination of applicants at their request without fee.

Wide publicity will be given this competition through the press and it is anticipated that it will draw the public's attention to the necessity for the maintenance of good dental health. Further details are published elsewhere in this issue.

Second Country Convention.

The Executive has approved of the final date for the Second Country Convention of the Association which is to be held at Orange from the 20th to 24th September, 1954, inclusive.

The Western Division to whom the responsibility of arranging the Convention has been delegated, has been most active in the initial arrangements for the Convention. A Convention Commission has been appointed and everything promises for a most successful Convention on this occasion.

Fluoridation of Drinking Water.

The Executive has been pleased to receive from the Federal office of the Association a report on the consideration given to this procedure by the National Health and Medical Research Council, on which the Australian Dental Association is ably represented by Professor A. J. Arnott.

In December, 1953, the Council passed two resolutions which are set out on previous pages of this Journal. The importance and application of the resolutions, from the viewpoint of the expressed policy of this State Branch of the Association regarding fluoridation, cannot be too strongly emphasised.

The Executive is now implementing a further approach to the Health authorities in this State in the light of the resolutions.

Suburban Dental Organisations Liaison Committee.

The Executive wishes to report that it has now established this Committee which consists of three senior members of the Executive and eight members of the Association appointed upon the nomination of the four suburban

dental organisations. The Committee has met twice and formulated a series of suggestions for closer liaison and co-ordination between the Association and the suburban dental organisations. Consideration is now being given to these general proposals.

Dental Attention—Far West Children.

The Executive wishes to express its appreciation of the willing support and co-operation of members in providing a roster to attend to the dental needs of the children at the Far West Holiday Camp at Manly in the New Year period.

Its thanks are also conveyed to the United Dental Hospital of Sydney, the Military authorities and dental supply houses for their co-operation in providing equipment and material.

This annual effort of the Association again proved most successful and of much assistance to the Far West Children's Health Scheme, whose appreciation has been conveyed to the Executive.

MEMBERSHIP.

New members.

Broadbent, Aubrey Henry, B.D.S.; Cantwell, Kevin Barry, B.D.S.; Craig, John Edward, B.D.S.; Davis, Betty Margaret, B.D.S.; Hastie, Peter, B.D.S; Henderson, Kenneth Graham, B.D.S.; Jenkins, Bruce John, B.D.S.; Murray, Francis Clement, B.D.S.; O'Riordan, Michael Henry, B.D.S.; Powers, Jack Milton, B.D.S.; Purnell, Frank Edward, B.D.S.; Setright, Thomas Henry, B.D.S.; Scott, Robert Ian, B.D.S.; Smith, Ronald John, B.D.S.; Tom, Clive Pearson, B.D.S.; Tucker, John Houghton, B.D.S.

Leave of absence.

Cummins, William Daniel, B.D.S.

Modified Leave of Absence.

Thomas, Dr. J.

Full to Qualified.

Godfrey, Keith, B.D.S.; Robinson, Miss P. M., B.D.S.

Full to restricted.

Lane, Dr. R. P.

Student Associate.

Rutherford, K. R.

Resignations.

Atwill, M. S.; Claydon, Thomas G.; Crouch, F. R.; Fryer, Frederic H.; Gates, John Thomas; Hudson, Arthur R.; Lyell, A. L.; Mann, Kenneth Joseph; Peifer, Henry James; West, George.

Deceased members.

Hume, William Kendal; Steele, David James; Walkley, Harry Charles.

Abstracts of Current Literature

A short note on certain selected articles appearing in current overseas journals.

Journal of the American Dental Association Vol. 47, No. 5, November, 1953.

PULP MANAGEMENT IN THE MIXED DENTITION: Irving W. Eichenbaum, and Naomi A. Dunn.

A well illustrated article setting out methods of retaining good functional arches throughout the period of mixed dentition.

Several techniques are described for pulpotomy. Both vital and non vital pulpotomies are described for use in temporary teeth, but the authors recommend the exclusive use of a vital pulpotomy for permanent teeth.

DIRECT AND INDIRECT FILLING RESINS: J. C. Paffenbarger, R. J. Nelsen and W. T. Sweeney.

A fine review of some of the physical and chemical properties of these resins. The authors anticipate that these materials, when their colour stability and adhesion to hard tissues is improved, will replace silicate cements.

DIRECT RESIN FILLINGS: H. D. Coy.

A clinical paper which forms a useful complement to the preceding review.

IMPROVING IMMEDIATE DENTURES IN GENERAL PRACTICE: M. G. Swenson.

A short article by this well-known author which deals with some of the most common points of neglect in the construction of immediate dentures.

Oral Surgery, Oral Medicine and Oral Pathology, Vol. 6, No. 11, November, 1953.

TREATMENT OF MULTIPLE FACIAL FRACTURES: D. E. Brannin and C. L. Wilkinson.

A case report describing the treatment of an injury received from a horse kick, which involved a fracture of the edentulous mandible and multiple fractures of other facial bones. Open reduction of the mandibular fracture and internal fixation of the upper facial fractures allowed the patient to be free of external fixation and gave a good end result.

HERPETIC STOMATITIS: I. G. Nathanson and G. E. Morin.

This report covers some 52 cases of herpetic stomatitis associated with generalised lymphadenopathy and preceding infectious mononucleosis. The use of Vitamin B complex is discussed.

Australian Dental Association (New South Wales Branch)

Dr. F. E. HELMORE
President

The following office-bearers were elected from the Executive for 1953-54:

President: Dr. F. E. Helmore.

Vice-Presidents: Mr. W. A. Grainger, Dr. A. G. Rowell.

Honorary Treasurer: Mr. J. G. Fletcher.

Dr. A. G. ROWELL
Vice-President

Mr. W. A. GRAINGER
Vice-President

The Executive elected at the Annual Meeting for 1953-1954 was:

Baulman, G. E.
Edney, N. E.
Fletcher, J. G.
Finnie, H. McD.
Gee, E. J.
Grainger, W. A.
Green, P. B.
Helmore, F. E.
Hunter, A. G.
Krauss, R.
Lawes, A. G. H.
Leeder, R. G.
Norton, R. C. Y.
Rowell, A. G.
Royse-Smith, T.
Tompson, F. E. R.

Mr. J. G. FLETCHER
Honorary Treasurer

New Books and Publications

DR. HOWE AND THE FORSYTH INFIRMARY, by R. W. Brown, Cambridge, 1952, Harvard University Press. (188 pp.). *Our copy by courtesy of the publishers.*

The profession of dentistry can well do with records of the men who have served her well, in order that a worthy background to our present activities might be painted. This short book is admirably set up and its being printed by the Harvard University Press marks its standard of production.

Not only do we learn of the work of Dr. Percy Howe but we also learn something of the Forsyth Dental Infirmary for children and of the Forsyth family who founded this establishment.

The life of any strong, dynamic personality invariably makes interesting reading and those members of the profession who read this book will be well rewarded.—H.R.S.

DENTISTRY IN ANCIENT INDIA, by K. M. Choksey, Bombay, The Popular Book Depot, 1953. (85 pp.). *Our copy by courtesy of the author.*

The size, production and contents of this little book are a very long way from the standards of the book reviewed above. However, just as the biography of Howe gathers together for us some of the ideals and philosophies of modern dentistry, so an attempt has been made here to recall and record some of the lesser known stories of the practice of dentistry in the earliest times of Indian history. It is therefore welcomed to our shelves.—H.R.S.

HEALTH SABOTEURS, by R. W. Davis, New York, 1953, Pageant Press. (306 pp., 47 illus.). *Our copy by courtesy of the author.*

Doubtless one must learn a great deal during a lifetime devoted to professional practice and often one will formulate concepts which, whilst lacking the proof of thorough laboratory investigation, may be most useful as aids to diagnosis or treatment. However, it is an exceptional man who can speak with authority on all the ramifications of some of the broader medical problems of today. In his preface to this book, Dr. Davis states that he has "put in writing the means . . . taken to acquaint parents with the danger in neglecting to have diseased tonsils and adenoids attended to." He then sets out in a series of thirty-two chapters his views on the relation of tonsils to such varied conditions as cancer, crime allergy and longevity. The chapters of interest to the dental profession are: "focal infection, mouth breathing, crooked teeth and facial deformities, dental caries and pyorrhea and speech defects." In these chapters the references and illustrations are too old to be of much service and the numerous verbatim statements often seem to do little to assist the author's opinions. Many dogmatic views are expressed and the phrase "I think" occurs with great regularity. Such sentences as "when teeth are crowded together, their nutrition is interfered with, just as trees and plants suffer from impaired food supply if planted too close together" make one wonder what reliance might be placed on the remainder of the author's observations.

We regret that we cannot agree with the numerous testimonials printed on the dust jacket.—H.R.S.

Classified Advertisements

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Applications are invited for appointment to the Clinic maintained by the Associated Pulp and Paper Makers Council, Burnie, Tasmania. Salary range on commencement is from £1300 to £1400 per annum, dependent on experience, with incremental increases up to £1500. Duties will be to attend to employees and their dependants attending the Clinic. No private practice will be allowed. Further details can be obtained by applications directed to the Secretary, Associated Pulp and Paper Makers Council, Box 191, Burnie, Tasmania.

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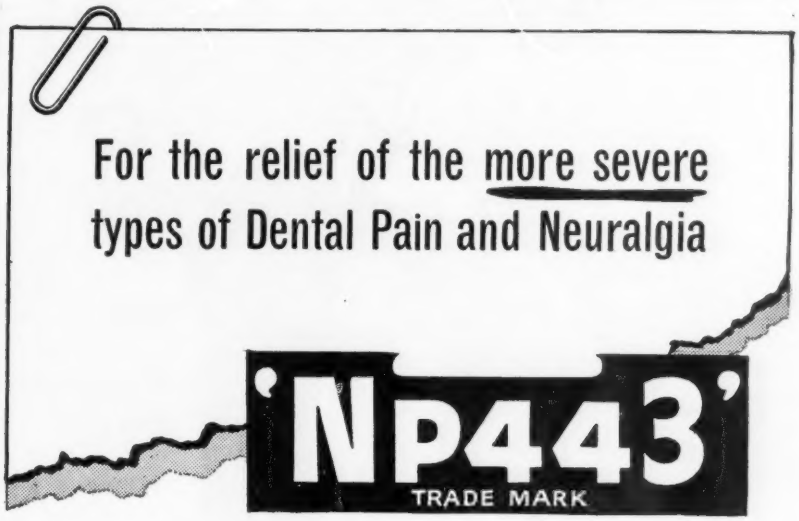

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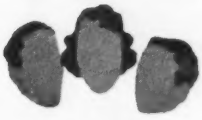

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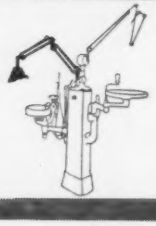

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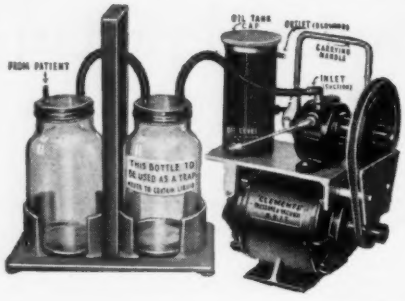

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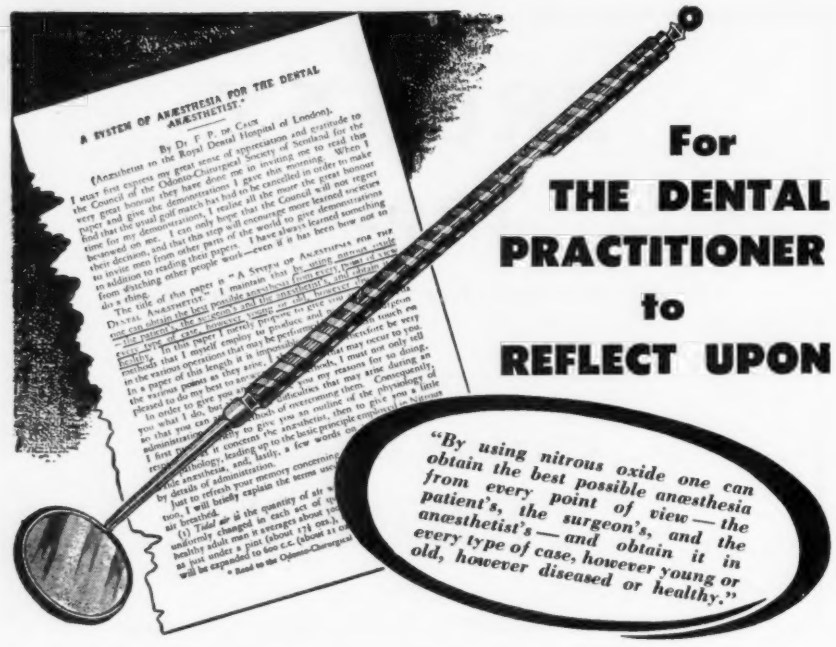

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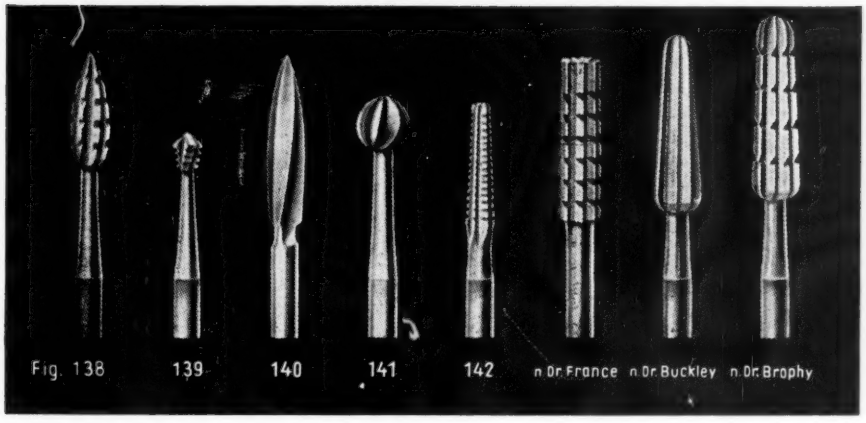

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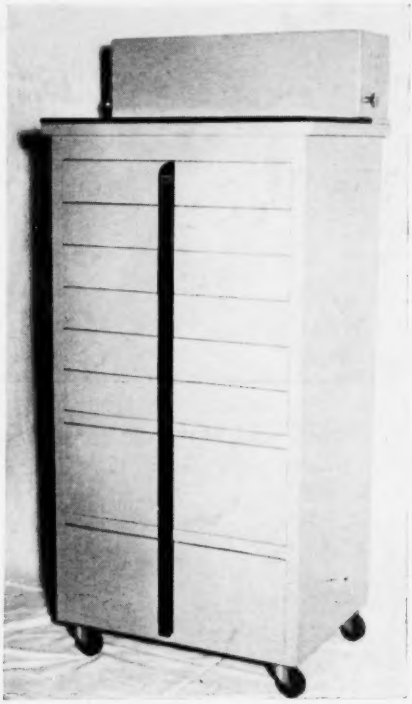
Height of working surface 40"



Width 21"
Depth 15"

Another great feature of the mobile cabinet is the fact that it may be easily removed from the surgery for floor cleaning purposes.

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